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RAILWAY LOADS FOR CENTRAL STATIONS.

The acquisition by the New York Edison Company of a railway load aggregating 30,000 kw is a matter for congratulation by the entire central-station industry. That the railway company was actuated by purely economic considerations there can be no doubt, for its Kingsbridge station is a model of its kind, recognized as one of the best in the country, and excelled by few in the efficient generation of electricity from coal. Therefore it has been demonstrated that, even granting excellent equipment and high load-factor, the argument for dual generating systems is fallacious; the central station is the rightful and logical custodian of all that pertains to the generation and distribution of electrical energy. The economic principle involved is by no means new. It has been reiterated from time to time both in this country and abroad, and has been driven home with force and logic by the astute central-station leader of Chicago. However, the present instance is the first wherein all doubt of the soundness of the proposition has been set aside. Heretofore railways were willing to listen to central-station argument when generating equipment was sadly in need of repair or when conditions were such that new capital had to be invested and was difficult to obtain. The economic principle, to be sure, is the same whether the existing railway generating equipment is poor or excellent, but in the one instance a psychological moment is relied on to drive home the argument and doubt remains as to whether the necessity of the moment or the principle involved is the deciding factor, and thus the righteousness of the cause may be said to lack confirmation. No such condition was present to befog the issue in the case now under discussion.

Central-station and railway conditions in New York City are peculiar and especially so in the borough of Manhattan. The railway load can be accurately predicted from hour to hour, but the central-station load is subject to great fluctuations. It is not a rare occurrence for the lighting load to vary by 50,000 kw in five minutes owing to a storm cloud passing over the city and to drop as rapidly in the next five minutes after the cloud has passed. Steam equipment and an adequate operating force are kept in readiness at all times to meet such emergencies, which may not present themselves once a month. While the greater day motor load will change entirely the complexion of this problem, it is merely incidental to the greater economies possible because of the better load-factor and diversity-factor after the systems are combined. With three stations two can be kept under constant load, with the third as a reserve for emergencies and possible peak-load conditions. The possibilities of consolidation are great and the engineering staff of the central-station company can be relied on to make the best use of them.

GERMAN CENTRAL-STATION STATISTICS.

A recent analysis of the central-station situation in Germany by the secretary of the chief German electrotechnical organization throws a striking light on the activity that has been displayed in central-station operations. The increase in the number of stations within the last decade has been a very striking one, and the growth has been upon the whole, and particularly within the last decade, a pretty steady one. For a brief period, during the somewhat critical years of 1901 and 1905, new building relaxed a little, but since then central-station work has progressed at a steadily increasing rate. The yearly increase in the number of works is now more than four times what it was fifteen years ago, and, what is of still greater public importance, the number of localities served has risen with astonishing rapidity. In the five-year period ended a year ago the number of places served has risen from a little over 2000 to nearly 11,000, and within the last two years the number has more than doubled. The same tendency has been at work in Germany as here toward the stretching out of lines into outlying territory and the gathering of new business from points previously unprovided with electrical supply. This tendency applies alike to strictly public works and those distributing for industrial work on a more modest scale. Of late there seems to have been a strong tendency toward the development of smaller electricity works with explosion motors. During the last two years there were more such plants put into operation, mostly on a small scale, than there were new steam plants, and the smaller water-power plants seem to have likewise increased with exceptional rapidity, just as is the case in other parts of the Continent. Transformer stations have likewise been multiplied, having nearly doubled their number in two years, as might be reasonably expected from the increase in the number of places served to which we have just referred.

From the figures compiled it is learned that the cheapest installations are those using steam as a motive power; next come the water-power plants, running less than 10 per cent higher than the steam plants, and then, barely 2 per cent higher in cost than the water-power installations, come those with explosion motors. All the costs per kilowatt have fallen greatly in the last ten years, those of the small plants of less than 100 kw by some 40 per cent, those of the large plants of from 2000 kw to 5000 kw by some 30 per cent. The decrease in average cost has been most conspicuous in the water-power installations and those with explosion engines. In recent years the costs for the smallest installations have run to nearly $300 per kw, while in the plants from 2000 kw up this figure has dropped to about $185. An interesting bit of information in this connection is furnished by comparison with the cost of Swiss stations. Here the water-power plants run singularly low in cost, less than 60 per cent of the value assigned to the German hydraulic plants, a fact perhaps due to the average high heads available in Swiss territory. In other classes of installations the German works have rather the better of the argument. Altogether, the most casual view of the statistics shows the great activity which has prevailed in Germany in the building of electricity works and the rapid extension of a general electricity supply to a very large number of service points. The wide extension of united networks which is so prominent a feature in northern Italy and parts of our own country seems not yet to have been fairly initiated in Germany, but will doubtless come in good time.

THREE-PHASE FLAME-ARC LAMPS.

One of the very interesting recent foreign developments in arc lighting is the three-phase flame-arc lamp. There is at present an increasing demand for alternating-current arc lamps, as yet rather incompletely filled. The alternating-current arc lamp has proved troublesome to develop for one reason or another, and although some twenty years have elapsed since such lamps came into commercial use, only within a very short time have they reached what one may fairly call a satisfactory stage of development. In the days of the old open arc lamp, a few good alternating-current lamps were developed, both here and abroad, but they never came into extensive use, at least on this side of the water. The fundamental difficulty was that of obtaining electrodes sufficiently soft and homogeneous to give really good service, a difficulty felt less on the Continent than here. From a practical standpoint nothing came of the alternating-current arc lamp until the development, in the closing years of the last century, of the inclosed lamp. This, as everyone recognizes, had admirable operative qualities, but it was an exceedingly inefficient source of light, the specific consumption being from 2 to 3 watts per candle. The carbon electrodes necessary for inclosed burning are fairly hard, so that the arc shows multiple images of moving objects even at a frequency of 60 cycles per second. At lower frequency the unsteadiness is so great as seriously to interfere with the usefulness of the lamp. With the coming of the flame-arc lamp this difficulty was ameliorated, the large volume of vapor given off tending to steady the light and muffle the variations, and at the present time the long-burning flame lamp adapted for alternating-current circuits is a fairly successful illuminant. However, greater steadiness of light is desirable, and it is natural enough that attention has been turned again to the use of composite three-phase lamps in which the sequence of the phases tends to diminish the variations in the light. The idea of taking advantage of this feature of three-phase distribution is a comparatively old one, some patents on the subject dating back to 1896. Indeed, at about this period adjacent lamps on three phases with the illuminations thoroughly over-lapped in time had been used in this country in mill lighting in an attempt to deal with a lower frequency than would readily admit of the ordinary use of alternating-current lamps. The expedient proved fairly successful, but was not adopted to any considerable extent.

The three-phase arc lamp apparently represents a very successful attempt to meet the requirements of first-class arc lighting, even when only moderate periodicities are available. The lamp is essentially a threefold one with three converging flame electrodes. The type of mechanism adopted is substantially that of the old-ribbon-feed lamp of American practice with escapement regulation, and with three independent adjustment magnets, one in each of the three phase leads. Such a mechanism well

executed ought to give, and from report does give, a very satisfactory lamp. The electrodes in this case are of the typical open-flame variety, a fact which contributes greatly to the steadiness of the light from the combined lamp. To judge from published reports, the most remarkable feature of the new lamp is the extraordinary range of its adjustability in both voltage and frequency. Tests from as low as 30 to over 100 volts have been made with rather remarkable results, the point of highest efficiency being reached at from 60 to 70 volts at the arc. The frequencies covered in the tests ranged from 18 to 56 cycles per second, and even at the lowest point little trouble was encountered from flickering, while at any ordinary frequency the familiar multiple images are reported to be entirely absent. A high light-giving efficiency may, of course, be expected from such a lamp, as it is a first-class flame unit. The candle-power distribution in space has the roundish characteristic familiar in lamps with converging electrodes, and consequently the lamp must be mounted rather high to insure the best illuminating effect. With a clear glass globe the specific consumption is consistently below 0.2 watt per mean lower hemispherical candle, and in some of the experiments fell even down to 0.1 watt per candle. This last figure, of course, represents somewhat extraordinary conditions, when the light source was operated at an intensity exceeding 10,000 candles for the triple arc. It is evident enough that the lamp here considered must be regarded as a flame unit of a very high order of performance as regards efficiency under all ordinary conditions. However, it is of interest not so much in the efficiency which is to be expected of powerful flame-arc lamps, but in the possibility of obtaining a successful and steady performance on relatively low frequency circuits. There are many cases, particularly on railway circuits and those connected with some of the large central stations, where 25 cycles has been, wisely or unwisely, adopted as the standard frequency. A lamp of the type here described can unquestionably be used in connection with such circuits with sufficient satisfaction to render it available for many cases where powerful arc lamps are required. Possibly the chief use for such a lamp would be in construction work or for special purposes where only low-frequency current is available. At all events, the lamp represents a singularly interesting development among powerful and efficient arc lamps, and as such is well worth bearing in mind.

LOW-PRICED FUELS FOR ENERGY TRANSMISSION.

History has abundantly demonstrated that it is possible for men to live agricultural lives of sociological stability without other available power than that of their own muscles or of the muscles of horses and oxen, provided the land is sufficiently fertile and the population sufficiently scattered. For centuries men have lived farming lives with success, trusting to wars, famines, diseases and migrations to keep the density of rural population down to the limit at which it could in the existing state of agricultural science be comfortably supported. In ancient times cities were few. The largest, such as Rome, Athens and Babylon, were small by comparison with the cities of our day, and even these largely depended for subsistence on military despotism and enforced tribute. The city of modern times became possible only with the discovery of coal and the invention of the steam engine, from which power could be copiously produced in communities to maintain industrial organizations, whereby men, densely collected into factories, could produce commodities they could exchange for necessities of life and farm products. The horse-power-hour of many engines is all that keeps men from either farming or village life, and if the supply of energy were withheld from cities these would melt away like icebergs in the Gulf Stream.

In the course of modern civilization the leading nations have committed themselves in large part to urban conditions, dense populations and industrial pursuits. To maintain such pursuits large supplies of energy are needed. The nation with the largest supply of available coal has the greatest economic advantage in the industrial race, especially if bodies of iron and other metals lie at hand for industrial use. In fact, until recently nations not possessing coal supplies have been thereby prevented from taking up industrial pursuits except along those special lines in which a minimum of mechanical energy is demanded. The development of high-tension electric transmission has already changed the fate of nations in so far as waterfalls might become substitutes for coal mines. Thus, in Europe, the nations in and around the Alps are tending to become industrial nations, competing, therefore, for markets, while, in the future, the Norwegian mountains of Europe and the Canadian mountains of North America seem destined to produce marked industrial effects, owing to the waterfalls that only mountainous regions can produce. Moreover, every kilowatt generated from water-power in a country where coal is mined may be regarded as saving at least 12 tons of coal per annum for other uses. In a paper recently read before the Leipzig convention of the Verband Deutscher Elektrotechniker and referred to in the *Digest,* Mr. D. F. Bartel discusses the possibility of supplying a large part of the industrial service of Germany from a network of high-tension conductors, fed with energy from central stations consuming lignite and peat. The paper shows that, whereas the coal beds of Germany are comparatively few, there are large beds of the inferior fuels lignite and peat scattered over the north German districts most remote from the coal. By collecting and burning these fuels under central-station boilers the paper suggests that the existing industrial needs of north Germany might be met, the railways being likewise electrified. While the complete scheme of the paper is not likely to be carried into effect for many years, it may well be expected that not only in Germany but also in Great Britain and other industrial countries high-tension networks will steadily extend themselves for the delivery of energy to industries, the energy being obtained either from waterfalls, coal mines or peat mines, whichever may have the local advantage as a source. The transportation of fuel for domestic furnaces may be necessary for an indefinite period, but the transportation of fuel for industrial purposes is likely to be checked by the growth of high-tension mains.

SECTIONS OF INTERNATIONAL ELECTRICAL CONGRESS.

The committee on organization of the International Electrical Congress, which will be held in San Francisco during September, 1915, has arranged tentatively the following list of sections:

(1) Lighting and illumination, including electric lighting of all kinds, electric radiation, etc.; (2) generation, transmission and distribution, including hydroelectric plants, steam stations, transformers, substations, etc.; (3) electric traction and transportation, including propulsion and electric vehicles; (4) electric power, including the application of electric motors to industrial purposes; (5) economics, including load-factors, power-factors and all problems affecting the economy of electric distribution, also regulation by public service commissions, etc.; (6) machinery, transformers and appliances; (7) telegraphy and telephony, including all communication and signaling by wires; (8) wireless telegraphy and telephony, including all communication by electromagnetic waves without wires; (9) electrochemistry and electrometallurgy, including electric furnaces; (10) electric measurements and instruments; (11) protective devices and transient and high-voltage phenomena; (12) miscellaneous.

I. E. S. CONVENTION PROGRAM.

At the sixth annual convention of the Illuminating Engineering Society, to be held at Niagara Falls, Ontario, Sept. 16 to 19, 1912, a report will be presented dealing with recent progress and developments in the lighting industry both in this country and abroad. The committee on nomenclature and standards will present a report dealing with certain definitions and terminology of illuminating engineering. "Steel Mill Lighting" will be the title of a report to be presented by Mr. C. J. Mundo, who is chairman of the committee on illumination of the Association of Iron and Steel Electrical Engineers. Mr. F. W. Goodenough, chairman of the council of the (British) Illuminating Engineering Society, will read a paper entitled "High-Pressure Gas Lighting." The program as thus far arranged includes the following papers:

"The Status of High-Pressure Gas Lighting," by Mr. George S. Barrows; "Recent Developments in Gas Lighting," by Mr. R. F. Pierce; "Indirect and Semi-Indirect Illumination," by Mr. T. W. Rolph; "Recent Developments in Series Street Lighting," by Dr. C. P. Steinmetz; "Research Methods," by Dr. E. P. Hyde; "The Problem of Heterochromatic Photometry and a Rational Standard of Light," by Dr. H. E. Ives; "Reflection from Colored Surfaces," by Mr. Claude W. Jordan; "Diffuse Reflection," by Dr. P. G. Nutting; "A Study of Natural and Artificial Light Distribution in Interiors," by Mr. M. Luckiesh; "The Physiology of Vision," by Dr. T. A. Woodruff; "The Efficiency of the Eye Under Different Systems of Illumination," by Dr. C. E. Ferree (this paper will be a report of a research carried on for the American Medical Association); "A Proposed Method of Determining the Diffusion of Translucent Media," by Mr. E. L. Elliott; "Illumination Charts," by Mr. F. A. Beuford; "The Determination of Illumination Efficiency," by Mr. E. L. Elliott; "An Absolute Reflectometer," by Dr. P. G. Nutting; "Colored Values of Illuminated Surfaces," by Mr. Bassett Jones, Jr. (this subject will be presented in the form of a series of experimental demonstrations).

Arrangements will be made for one session to be devoted to the discussion of miscellaneous phases of illuminating engineering, for the purpose of bringing forward certain features not covered by the formal convention papers.

N. E. L. A. AFFAIRS.

A very fully attended meeting of the executive committee of the National Electric Light Association was held in New York on July 25, there being present Messrs. F. M. Tait, president; C. L. Edgar, W. C. L. Eglin, W. W. Freeman, E. W. Lloyd, J. F. Gilchrist, J. B. McCall, R. S. Orr, H. H. Scott, Arthur Williams, J. S. Whitaker, T. C. Martin, secretary, and S. A. Sewall, assistant to the secretary. Mr. R. F. Pack, the newly elected president of the Canadian Electrical Association, was at the offices of the association on July 24, having come on to attend the meeting, but was recalled to Toronto the same evening by urgent business. Mr. Henry L. Doherty joined the committee by request during the morning.

The secretary presented the membership report, showing a net total of 12,185 as of July 24. A total of 1041 were admitted at the meeting.

President Tait directed attention to the growing strength of the affiliation movement, which now is active in Ohio, Alabama, Florida, North and South Carolina, West Virginia, Colorado and California.

A proposal was discussed from Chairman Schuchardt of the Commonwealth Edison Section of Chicago suggesting the formation of an Associate Class B membership for employees receiving less than $75 per month, who would pay dues of only $2 per year instead of $5, but would receive only the monthly *Bulletin* and would not be eligible as section competitors for medals or as convention delegates. In other words, they would participate in the local work of the section. A somewhat similar plan has already been authorized for Milwaukee. The subject was referred to the committee on constitution and by-laws.

Past-president Eglin made a report as to the status of the work of the resuscitation commission, which has received an enormous amount of publicity throughout the world, with a corresponding inquiry for the chart and booklet of rules for the treatment of shock and burns. Since the Seattle meeting the commission has slightly modified the phraseology of these documents and has made new engravings of a more exact nature to be included. These final documents will be issued in August, and the commission, financed by the association and aided in its experiments by member companies by the loan of apparatus, etc., will now take up one or two very important matters bearing on this investigation, the physiology of which is still obscure.

President Tait called attention to the recommendation in Past-president Gilchrist's Seattle address that there be an educational committee to keep in close touch with the educational institutions of the country, to help in forming clearer ideas of the principles for which the association stands and in training young men for the industry. The suggestion was heartily approved, and the formation of such a committee authorized.

President Whitaker of the New England Section called attention to the meeting in Boston in October, and expressed the desire for the attendance in general of the National Electric Light Association membership at that time in view of the fact that comparatively few national members had been able to attend the annual convention at Seattle. The section expressed its willingness to expand its program and make the meeting cover three days. The proposition received the indorsement of the committee.

The affairs of the Commercial Section were given considerable attention, Chairman Lloyd outlining its condition, plans and work. In view of the issuance of the "Commercial Digest" by the section, and its overlapping with the "Solicitors' Handbook," it was decided to merge the two publications in the hands of the section. The "Digest" is issued in loose-leaf form, and is easily kept up to date. It goes to all members of the section, which also is now planning three or four new publications to be issued this year.

NEW YORK EDISON COMPANY SECURES 30,000-KW RAILWAY LOAD.

The Third Avenue Railway Company has entered into a contract with the New York Edison Company to supply it with all of the electrical energy necessary for the operation of its various lines in the city of New York. As part

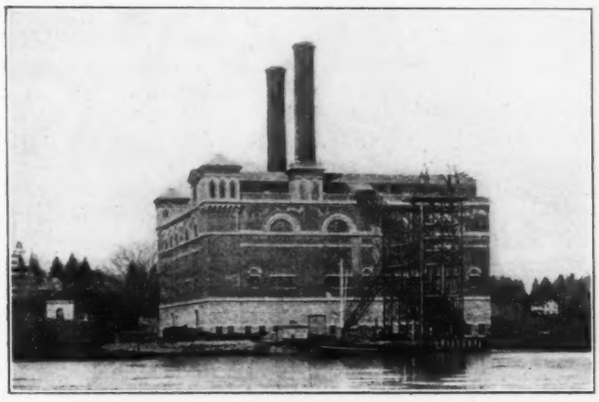

Fig. 1—Exterior of the Kingsbridge Station of the Third Avenue Railway Company.

of the agreement the Kingsbridge station of the railway company will be leased to and operated by the Edison company. The actual plans are still in a formative stage, since the contract does not become operative until about October. The purpose of the contract is, of course, to secure higher operating and investment economies, which means that the two systems will be so merged and jointly operated that that which is best in the one will be utilized to contribute to the improvement of the other. Both the Waterside and the Kingsbridge station are equipped with 6600-volt, three-phase, 25-cycle generators.

In addition to the higher load-factor possible on the general system, it is expected that there will be a large investment saving on future extensions, operating economies through the joint occupancy of substations and such other advantages as may accrue to a general system in operating the large generating stations of the two corporations at the most economical loads. It is significant that the station and generating equipment of the Third Avenue Railway Company are still in good operating condition, having been maintained in and operated at a high state of economy and efficiency.

The Kingsbridge station is located at 218th Street and the Harlem River. It was designed by Westinghouse, Church, Kerr & Company, and the first unit was placed in operation about 1903. The river affords an abundant supply of condensing water and facilities for the delivery of coal in barges. In mechanical design the station embraces the multiple-unit idea noticeable in large power stations, but the engine and boiler equipment is divided into four distinct plants, each of which may be independently operated and yet so interconnected with the others that they can form a single unit.

The equipment consists of eight vertical cross-compound Westinghouse engines, directly connected to 3500-kw, 6600-volt, three-phase, 25-cycle Westinghouse generators. Steam is supplied by thirty Babcock & Wilcox water-tube boilers set in batteries of 1000 hp. The coal bunkers are on top of the boiler room, fuel being delivered to them by conveyors and fed by gravity to automatic stokers with which the boiler furnaces are equipped. Ashes are handled by gravity from the ash pits to conveyors in the basement, whence they are taken to bunkers on the dock which discharge into barges. A feature of the layout is a large central condensing plant of the barometric type located in the boiler room which serves the entire station.

The space required per kilowatt in the Kingsbridge station is 1.16 sq. ft. for boiler and engine rooms together. Although test figures are not available, it is generally understood that the station is capable of delivering a kilowatt-hour at the switchboard for approximately ½ cent.

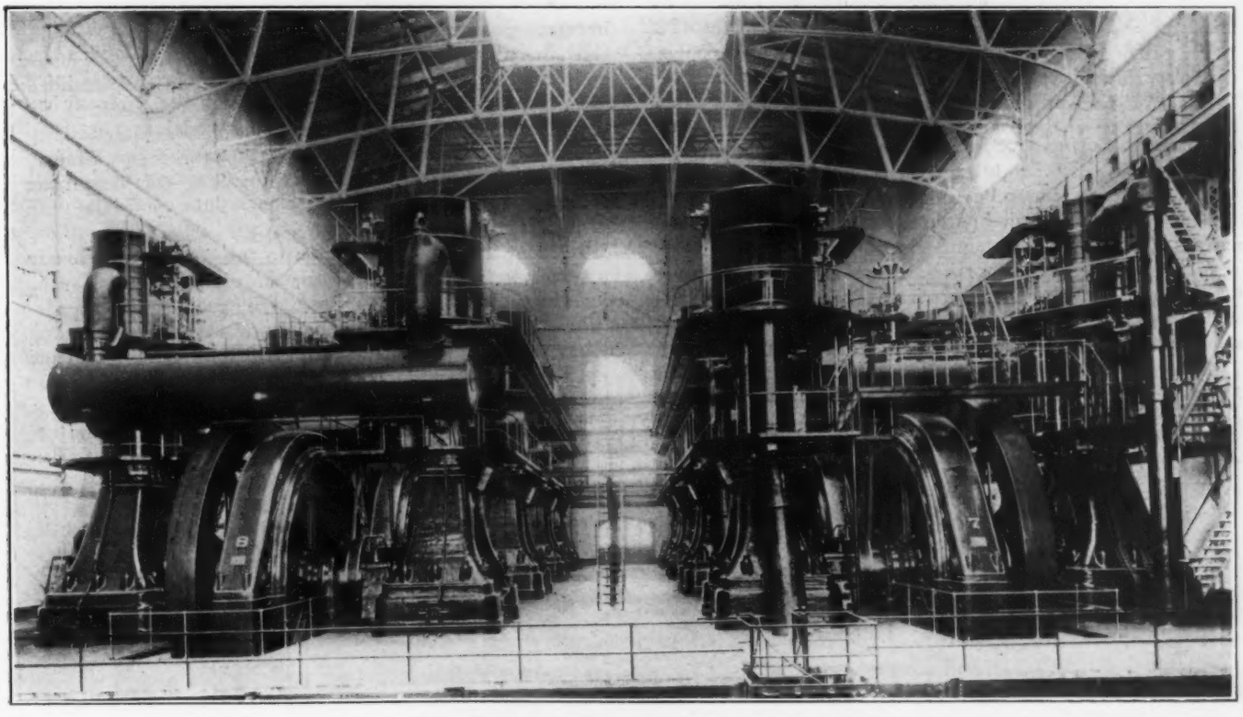

Fig. 2—Interior of the Kingsbridge Station.

The contract may be taken as a further evidence of the far-sighted policy which has marked the administration of Mr. F. W. Whitridge, first as receiver and now as president of the Third Avenue Railway Company. On behalf of the New York Edison Company the contract was signed by Mr. Nicholas F. Brady, first vice-president.

FINANCIAL REVIEW OF THE GENERAL ELECTRIC COMPANY.

The announcement made last week by the General Electric Company that a 30 per cent stock dividend would be declared in addition to the regular quarterly dividend of 2 per cent caused considerable comment. Furthermore, the directors have authorized an issue of 5 per cent debenture bonds, limited to $60,000,000. The dividend disbursement will amount to more than $23,000,000. Shortly after the announcement was made the company offered the following statement:

"It would seem unnecessary to make any further statement, but in view of the fact that the sale of rights to new stock is being discussed on the Street, it should be stated that no new stock is being offered for subscription, the $30 per share not being an offering of 'right' in any sense, but a direct distribution of stock from the surplus earnings of the company, in partial recognition of dividends which in prior years have been omitted or reduced. An issue of debentures was authorized for the purpose of securing capital for the varied corporate securities of the company from time to time in future years."

The company's present financial position is made clear from the April balance sheet reproduced in Table I.

TABLE I.—BALANCE SHEET, APRIL, 1912.

Assets:	
Real estate and machinery	$19,987,877
Merchandise	30,905,405
Cash and debts receivable	35,693,266
Patent rights	14,809
Miscellaneous	28,955,175
	$115,556,532
Liabilities:	
Capital stock	$77,581,200
Accounts payable	5,412,841
Funded indebtedness	2,560,000
Surplus	30,002,491
	$115,556,532

This reveals a working capital of about $61,000,000 and a book value of $139 per share. The company's business is said at the present time to equal a rate of about $90,000,000 to $95,000,000 per year. The strong position which the company now occupies is in marked contrast with its early history. The General Electric Company was incorporated on April 15, 1892, being a consolidation of the Edison General Electric Company, the Thomson-Houston Electric Company and the Thomson-Houston International Electric Company. Business was commenced on June 1, 1892. At the start the company was overcapitalized and mismanaged, and through the attempt to finance electrical enterprises of many sorts embarrassment was soon felt. At the end of the first fiscal period, on Jan. 31, 1893, the company's patents, contracts and rights were carried at $8,159,264, and a high value was placed upon the stocks of underlying and local operating companies which were held in the treasury. A financial résumé of the company's history is presented in Table II, which reveals the general trend of its affairs since it was formed.

The over-capitalization made it necessary to scale down the assets in the second year of operation, with a consequent deficit, as shown, for 1894. After the first two years, no dividends were paid until 1898, when the situation had become so acute that it was necessary to reduce the capital stock 4 per cent. As a result it was possible to convert a long-standing deficit into a surplus, and during the year which ended Jan. 31, 1899, the cumulative 7 per cent dividend on the preferred stock from July 1, 1893, was declared and paid. In the following year the company's increasing prosperity made it possible to pay a 4½ per cent dividend on the common stock, and by 1902 the surplus had accumulated to an extent which permitted a stock dividend of 66 2-3 per cent, thus restoring the stock which had been reduced in 1898. Furthermore, the stockholders received valuable rights to subscribe at par for new stock issued in 1904, 1905 and 1906.

The 30 per cent stock dividend just announced will increase the capital account about $23,000,000 and reduce the surplus to some $6,000,000 in round figures. This action places the company in a position to distribute still larger profits without raising the dividend rate, at least for the present, although one report states that the next favorable development will be the placing of the stock on a 10 per cent basis.

The company's strong position financially is due in large part, aside from its phenomenal growth, to the conservative policy of charging off assets of an intangible character and providing amply for depreciation of the factory plants.

The operations of the General Electric Company now, as heretofore, cover more than manufacturing and extend into the operating field to a material extent. This fact, coupled with the very large share of the electrical manufacturing business of the country which the company controls, renders its operations of substantial importance to the general public. The company now holds the securities of other companies, largely in the operating field, to the extent of nearly $29,000,000. The report of the Ex-Commissioner of Corporations, Mr. Herbert Knox Smith, on water-power development in the United States, abstracted in our issue of May 11, has special interest in this connection and shows that the General Electric influence in this field is larger than that of any other single group of interests and comprises nearly one-half of the developed power.

TABLE II.—CONDENSED FINANCIAL STATEMENT, 1893 TO 1911.

Year.	Common Stock	Preferred Stock.	Debenture Bonds.	Annual Sales, Including Royalties.	Net Earnings, All Sources.	Dividends Paid.	Cumulative Surplus.
1893	$30,426,900	$4,236,900	$10,000,000	(Not given)	$3,356,593	$1,971,056	$1,024,955
1894	30,459,700	4,251,900	10,000,000	(Not given)	3,699,923	1,655,151	*12,454,967
1895	30,460,000	4,252,000	8,750,000	$12,961,214	1,811,748	.....	*14,794,717
1896	30,460,000	4,252,000	8,750,000	13,315,667	1,826,467	.....	*13,917,071
1897	30,460,000	4,252,000	8,000,000	12,820,396	1,983,487	.....	*12,957,413
1898	30,460,000	4,252,000	6,000,000	12,524,938	2,187,035	.....	*11,725,561
1899	18,276,000	2,251,000	5,700,000	16,472,022	3,570,000	1,609,552	156,571
1900	18,276,000	2,251,200	5,300,000	23,248,170	4,710,983	1,001,004	2,353,031
1901	21,400,300	2,251,200	1,534,000	29,081,642	5,824,725	1,728,249	6,628,534
1902	24,910,900	.....	372,000	32,479,428	7,659,656	1,955,657	15,287,141
1903	41,880,733	.....	2,148,400	37,500,556	9,303,518	2,677,263	4,482,702
1904	43,866,700	.....	2,131,400	41,699,617	7,865,376	4,482,701	7,293,688
1905	48,247,943	.....	2,127,400	39,950,427	6,437,619	3,684,384	9,569,197
1906	54,286,750	.....	2,102,000	44,419,613	7,145,771	3,861,062	12,027,295
1907	65,134,300	.....	2,102,000	a60,071,883	8,098,140	4,344,342	15,110,796
1908	65,167,400	.....	14,974,750	72,484,988	6,586,653	5,183,614	16,513,836
1909	65,178,800	.....	14,963,000	a44,540,676	4,766,332	5,214,023	16,102,062
b1909	65,179,600	.....	14,962,000	a51,656,631	6,015,657	5,214,352	17,381,380
1910	65,179,600	.....	14,962,000	a71,478,558	10,855,692	5,214,368	23,022,706
1911	77,335,200	.....	2,806,000	a70,383,854	10,562,806	5,806,344	29,019,893

*Deficit. aSales billed. bCovers 11 months.

MAINE ELECTRIC ASSOCIATION CONVENTION.

At the fourth annual convention of the Maine Electric Association, held in Portland on July 25 and 26, the constitution was amended so as to broaden the field of the association. In the past the membership has been confined to the managers and operatives of electric lighting plants, but in the future the employees in the electrical departments of the telephone and street-railway companies will be able to join the association and partake of its benefits. The election of officers resulted in the choice of the following for the ensuing year: President, Mr. H. B. Ivers, Portland; vice-presidents, Messrs. John H. Maxwell, Livermore Falls, and Harry E. Plummer, Lisbon Falls; secretary and treasurer, Mr. Walter S. Wyman, Augusta; executive committee, Messrs. Fred D. Gordon, Waterville; M. H. Blackwell, Fairfield; John H. Maxwell, Livermore Falls; C. E. Smith, Newport; J. A. Fleet, Portland; Harry E. Plummer, Lisbon Falls; Walter S. Wyman, Augusta, and Fred O. Eaton, Rumford Falls.

ANNUAL REPORT OF THE COMMISSIONER OF PATENTS.

The annual report of the Commissioner of Patents, covering the year ended Dec. 31, 1911, shows that 67,370 applications were received for mechanical patents, 1534 applications for design patents and 217 applications for re-issues. During the year 33,927 patents were issued, including designs, and 157 patents were re-issued. The total receipts were $2,019,388 and expenditures $1,953,690, leaving a surplus of $65,698. The last amount, added to the previous surplus, leaves a total on Dec. 31, 1911, of $7,063,926. The commissioner states that in the appropriation bill he has asked for five additional examiners to aid in the work of classification, which is now under way. No adequate classification of patents has been completed since the Patent Office was established, but the work is now about half finished. The number of American patents already issued amounts to over 1,000,000, and in addition there are between 2,000,000 and 3,000,000 foreign patents and about 50,000 volumes of scientific and technical works in the library of the bureau, all of which must be examined and abstracted.

The commissioner called attention to pending legislation relating to patents, and referred to bill H. R. 7609, which provides for the elimination of one of the appeals within the office. It is intended to accomplish this by forming a single appellate tribunal composed of the commissioner, first assistant commissioner, assistant commissioner and examiners-in-chief, any three of whom shall constitute a quorum. All appeals will go directly to this body; the final appeal would lie to the Court of Appeals of the District of Columbia. Bill H. R. 7711 provides safeguards against possible mutilation or fraudulent amendment of patent applications during the pendency in the office. This would be accomplished by requiring each applicant to file two photographic copies of each drawing embraced in a patent specification. The commissioner also recommended the passage of bill H. R. 8388, reducing from one year to six months the period within which an applicant is allowed to amend rejected claims.

Attention was called to the heavy appeal docket in the Patent Office, which is proving burdensome to dispose of. During the year 1911 1523 interferences were declared. Bill H. R. 7609 was prepared with the object of obtaining needed relief. Approval is expressed of the efforts of the American Bar Association to obtain legislation for the establishment of a Court of Patent Appeals, and it is pointed out that the construction of a patent by the Circuit Court of Appeals of one jurisdiction is effective only over that jurisdiction and has no legal effect in any other of the several circuits, except through the exercise of comity.

The report concludes with a reference to the need of reorganizing the scientific library of the bureau and preparing a digest of the subject matter therein, and also draws attention to the urgent need of relieving the extremely overcrowded and hazardous condition of the Patent Office. The present accommodations are obsolete and inadequate both as to space and equipment, and the extremely valuable contents are likely to be destroyed by fire at almost any time. It seems imperative that some action on this situation should be taken at an early date.

ANNIVERSARY OF THE ROYAL SOCIETY.

BY BROTHER POTAMIAN.

On Tuesday, July 16, Fellows of the Royal Society and delegates from academies, societies and universities from all parts of the three kingdoms, from the Continent and from far-off colonies met in London to celebrate the two hundred and fiftieth anniversary of the inauguration of the society. The functions commemorative of this historic event were partly of a religious and partly of a social character. On the Jubilee Day, Tuesday, July 16, a special service was held in Westminster Abbey, which was followed by a formal reception of the delegates at Burlington House in the afternoon and by a banquet in the Guildhall in the evening. Garden parties were held on Wednesday at Lyon House by the Duke and Duchess of Northumberland and at Windsor Castle on Thursday afternoon by the King (as patron of the society) and the Queen.

Among the early Fellows of the Royal Society were Wren, Boyle, Hooke, of "Hooke's law" fame; Stephen Gray, the pioneer electrician; Papin, the inventor of the "digester" and piston steam-engine; Newton, who was president of the society for a period of twenty-four years; Halley, who published Newton's "Principia" at his own expense, and Michell (Rev. John), the inventor of the torsion balance which yielded fruitful results in the hands of Cavendish and Coulomb.

The Royal Society was founded for the purpose of improving "knowledge of all natural things and all useful arts, manufactures, mechanic practices and inventions by experiment," but it was not to "meddle with divinity, metaphysics, morals, politics, grammar, rhetoric or logic."

For the oldest and best-known award of the Royal Society funds were left by Sir Godfrey Copley, and the first beneficiary was Stephen Gray, to whom the interest on the bequest of £100 was given in 1731 and again in 1732 for his method of sending signals along wires by electrifying them at one end so that they attracted light bodies at the other, a method of transmission which involved the twofold discovery of conduction and insulation.

In 1736 the award took the form of a gold medal—the Copley medal—and many of the most distinguished men in all departments of science throughout the world have been the honored recipients of this "ancient olive crown of the Royal Society," as Davy termed it. Our countryman Franklin, whose letter on the identity of lightning and electricity was dismissed by the learned Fellows with derisive laughter in 1750, was, nevertheless, elected a member of the society a little later and was the recipient of the Copley medal in 1753.

Other medals at the disposal of the Royal Society are the Rumford medal (biennial) for which Benjamin Thompson, of Rumford, Mass., better known as Count Rumford, left a sum of £1,000 in 1796; two "Royal" medals founded by George IV and renewed annually by his successors; the Davy medal, which owed its institution indirectly to the safety lamp, and the Hughes medal, for which a bequest of £4,000 was left by Prof. David E. Hughes, the Anglo-American electrician who at one time was professor of music and physics at Bardstown College, Kentucky.

OHIO ELECTRIC ASSOCIATION PAPERS.

The Ohio Electric Light Association held its eighth annual convention at Cedar Point, Ohio, on July 16, 17 and 18, as previously noted. Below are given abstracts of the papers read at the convention and the discussions following their presentation.

ELECTRICAL TRANSMISSION.

The report of the committee on electrical transmission, prepared by Messrs. M. H. Wagner, Dayton; W. S. Townsend, and J. T. Kermode, Cleveland, was read by Mr. Wagner. An interesting addendum to the report was a compilation of data from a number of transmission lines operating at from 6600 to 33,000 volts in Ohio, Indiana and Kentucky. The practical working radius of 2300-volt transmission is very limited, being about one mile for 25 cycles and 3700 ft. for 60 cycles, when the wire is loaded to its carrying capacity and the pressure drop is 10 per cent. The transmission-line design centers on the operating voltage. A good rule is 1000 volts per mile of line. For example, a 6-mile line would require 6000 volts. The usual spacings may be summarized as follows:

Volts.	Minimum Spacing, Inches.	Maximum Spacing, Inches.
6,600	12	48
13,200	18	36
22,000	30	36
33,000	36	72

The greater the number of provisions against lightning the better the possibility for uninterrupted service. The aluminum-cell arrester has proved very efficient. It not only affords a path to ground for lightning but aids in removing all internal line disturbances. However, this arrester has a serious disadvantage in the necessity for charging it each day, thus making its efficacy dependent on the operator. The multi-gap arrester also relieves surges and is found very effective up to 13,200 volts. Ground wire is best placed at the top of the line structure so that it has a shade angle of 45 deg. to the outside conductors. It may be a 3/8-in. stranded galvanized plow steel or bimetallic wire. Such a ground wire is good for mechanical reasons, for it ties the tops of the structures together, thereby adding strength to the construction. The ideal construction comprises ground wires at the highest points of the poles and aluminum-cell arresters at both ends of the line and in the center.

Discussion.

In the discussion which followed Mr. D. L. Gaskill, Greenville, detailed the experiences of his company in building a 26-mile, 33,000-volt, single-phase line. Adopting what seemed to be good business principles, a number of supply companies were called upon to submit bids for poles, wire, insulators, etc. The house which made the lowest offer received the pole order, kept it six weeks, peddled it around the country and finally notified the customer it would be unable to carry out its contract. The order had then to be given to a firm of known responsibility, at an advance of $300, besides the loss of six weeks' time for construction work. A similar experience was encountered in buying the insulators. After accepting the order the firm making the low bid finally admitted it could not supply the goods, and the purchase had to be made elsewhere at higher cost. Mr. Gaskill pointed to this as a lesson that companies planning to build should submit their specifications to reliable houses in the first place. The Greenville transmission line follows the county roads where possible, since experience has shown that the average farmer, when approached by a corporation for right-of-way permission, becomes unreasonable in his demands for compensation. The single-phase line cost $800 per mile, and Mr. Gaskill expressed doubt whether, with the advances in single-phase motor construction, polyphase service would ever be necessary in the district served. If required, his company would prefer to assist the customer in the purchase of his motor, rather than incur the additional investment in the line.

Mr. John Gilmartin, Toledo, pointed out the desirability of placing the distribution voltage at a high enough value to serve all future customers. He also mentioned the larger use made of aluminum in England and Canada. In the United States, he said, aluminum prices depend upon the copper tariff. Lightning arresters, while of value for protecting stations and apparatus, are useless, said Mr. Gilmartin, in preventing direct strokes on the line.

Mr. Weare Parsons, Springfield, suggested 6600 volts as the practical limit for multi-gap arresters. The protection of lines against surges alone, he added, would justify the use of arresters. Mr. M. H. Wagner, Dayton, mentioned the difference found in aluminum-cell cones made from the same batch of metal. Prof. F. C. Caldwell, Columbus, compared the electrical conditions of a transmission system to the vibrations of a plucked string, showing harmonics and nodes. Impedance coils are useful largely because, under surge conditions, they represent the equivalent of a long section of line, and thus aid in deflecting discharges into the arresters. Extensions to a system may, however, destroy such an adjusted positioning of arresters. In closing, Professor Caldwell quoted the advice, "Spend all the money you can spare on lightning arresters, and then trust to Providence."

Mr. S. M. Rust, Greenville, described the arrangement of transformers on the line mentioned by Mr. Gaskill. Mr. J. D. Lyon, Cincinnati, reported a lightning stroke at the local power house which perforated the oil-filled tank of an induction regulator, at the same time setting fire to the stream of oil from the leak. This poured down on the main outgoing cables, burning them and crippling the system. Mr. C. I. Crippen, Youngstown, recounted how a set of multi-gap arresters was replaced with aluminum cells, a ground wire later being added on the line. Best results were obtained, however, by returning to multi-gap operation, with the ground wire in position. Mr. A. B. Young, Kent, told of making ground connections to 10-ft. sections of pipe having their lower ends flattened into a pick-point and the upper ends sealed and closed with the connecting wire. The pipes were filled with water to insure contact with the wire, and after twelve years' use only 3 in. of the water was found to have evaporated. Mr. J. B. Garden, Bridgeport, remarked the surprising difference in lightning conditions in his city and in Wheeling, just across the river, despite identity in construction and methods. Mr. A. A. Pointer, Antwerp, testified to the satisfactory operation of his own line without either arresters or ground wires. Mr. S. H. Bruce, Garrettsville, recommended the familiar telegraph expedient of running a ground wire up each pole, ending in a loop at the top. Mr. J. N. Sharp, Toledo, described a ground-wire support made by bending a 6-ft. section of 3/4-in. pipe so as to clear the phase wires.

In a continuance of the same discussion on Friday Mr. W. S. Culver, Schenectady, N. Y., explained that no arrester can protect against a direct lightning stroke. The efficacy of its protection is also at all times dependent on a ground connection of good quality. Mr. Culver mentioned the introduction of a new arrester designed for sale at a low price, but arranged to give a reasonable quality of protection. He also described the arcing-ground suppressor for station use. In answer to queries from Messrs. W. J. Conrad, Weare Parsons, W. C. Anderson and John Gilmartin, Mr. Culver stated his opinion that there is no objection to installing arresters on poles with transformers if proper construction is used. While multi-gap arresters

can be used up to 10,000 volts, aluminum cells, he declared, will give better service, except where inaccessible for the charging necessary for reforming the film. The use of arresters on secondary lines, he observed, depends upon the latter's length and exposure, usually being considered unnecessary for ordinary runs, especially where a grounded-neutral system is employed. Others who took part in the discussion were Messrs. W. C. Andrews, Canton; F. M. Tait, Dayton; J. B. Johnson, Massillon, and O. H. Caldwell, Chicago.

FIXING OF ELECTRIC RATES.

In his paper on "Rate Making," presented on Wednesday morning, the Hon. Halford Erickson, chairman of the Railroad Commission of Wisconsin, Madison, first traced the history of monopolistic undertakings down to their regulation by governmental authority intrusted to commissions. A public-utility company, he declared, is entitled to a reasonable rate of return after paying operating expenses, depreciation and interest on the property required to serve the public. Cost of reproduction is now receiving principal consideration in fixing plant value, the cost of building the plant new, diminished by its depreciation, being taken as its present value. This figure may properly include "going" value, or the cost of getting the business. It is, however, free from such elements as mistakes in management and other fallacious values which may have had a part in the actual cost. Original cost covers material, labor, superintendence, organization, and even the discounts necessary on securities and the cost of promoting. Reproduction cost is based on inventory and appraisal. Allowance for land appreciation is a moot question. When a difference exists between original and reproduction costs the value to be chosen must be governed by local conditions. Although depreciation has been viewed as both a capital charge and as akin to repairs, the present view, said the speaker, tends to the deposit of a fixed amount yearly in a depreciation fund, which is set aside to meet the cost of renewals. The rate allowable depends on many things, including the use made of the depreciation-fund money while accumulating. For electric plants the rate of depreciation permitted has been from 4 to 5 per cent. What shall constitute a reasonable rate of return is also fixed by the current value of capital and business ability. If less than this, the public suffers, and if more, the resulting influx of capital and men soon adjusts the inequality. Eight per cent on the cost value has been considered fair. A system of uniform accounting and records would be valuable to the utility for its own purposes alone of comparing costs, etc. Earnings, to be reasonable, should cover depreciation, profit and operating expenses. To these, declared Colonel Erickson, the company is entitled by law and in fact. Each department and customer should be required to bear his own share of the cost of service, classified under the various heads of demand, quantity, load-factor, etc. In the absence of demand meters the "active load" may be taken as an equitable basis in figuring the demand charge. Under some conditions it may be proper to take on additional motor load at low rates if these pay sufficient margin to apply on the fixed plant charges.

Discussion.

In answer to a question by Mr. M. E. Turner, Cleveland, Colonel Erickson insisted that there would be little difference, beyond the cost of billing, collection, etc., in serving 1000 1-kw customers and one 1000-kw customer, each using service at the same load-factor. Where a line has to be built for some distance to reach a customer, the latter may be charged at a higher rate, the Wisconsin commission sanctioning this as a case of "just discrimination" as compared with a customer next door to the plant who properly secures the lower regular rate. If, however, these two customers are engaged in the same line of manufacture the law may prevent such discrimination. Where two utilities operate in the same community, one plant being nearer a given customer than the other, the commission has required each company to charge the same rates to the customer. "Competition," said the speaker, "is out of question in the utility field, and ultimately means destruction."

In reply to a question by Mr. F. M. Tait, Dayton, Colonel Erickson said that the Wisconsin commission has several times found it necessary to raise existing electric rates, both in sections and the schedule as a whole, in order to insure proper earnings for the company. Numerous other cases have occurred in small telephone companies, started and run without view to depreciation. Such raising of rates is unpopular, and the commission has been criticised, but, said the chairman, it must nevertheless do its duty in deciding cases on facts.

Hon. O. P. Gothlin, chairman of the Ohio Utility Commission, Columbus, pointed out the essential differences between the Wisconsin and Ohio commission laws as passed by the legislatures. In Wisconsin the commission has jurisdiction over municipal plants, while the Ohio commission has not. This condition results from the "home rule" cry, popular just now. Under the Ohio law the only vice in rates can be that of discrimination, since the rates themselves are prescribed by the local municipalities. While stockholders are entitled to fair returns, they are not, insisted Mr. Gothlin, entitled to returns for which no compensation or inadequate consideration has been given, or where unnecessary margins have been received in placing the securities.

Mr. J. D. Lyon, Cincinnati, directed attention to the importance of quantity discounts, which, he said, seem in general to be governed by a law approximating that of compound interest. In Cincinnati the customer charge is made high, while the rate of the quantity discounts is accordingly large. Mr. W. C. Anderson, Canton, pointed out that one large customer may be served with a less expensive distribution system and with larger transformers, costing less per kilowatt, than would be necessary for equivalent service to a number of small users. Prof. F. C. Caldwell, Columbus, spoke of the difference in depreciation chargeable to actual wearing out in service and that caused by simple obsolescence. Mr. E. E. Witherby, Chicago, said that in New York State the commission has no control over local block systems, this resulting in price cutting and practically necessitating secret rebates. Mr. John Gilmartin, Toledo, again directed attention to the greater cost of serving small customers. Messrs. Erickson and Gothlin received the unanimous thanks of the convention.

THE UTILITY AND THE PUBLIC.

Mr. D. L. Gaskill, Greenville, Ohio, followed with his paper, "The Public Utility and Its Relation to the Public." The public, said the speaker, has a right to demand good service commensurate with the size of the municipality served; reasonable rates which will encourage industry and be within the means of all classes of citizens; honest treatment on the part of the utility so as to insure every consumer that he is getting what he pays for—no more, no less—and equal rights that will guarantee to the patron that he shall have the same rate and treatment as all others having like service.

The utility on its side has rights which the public likewise should be bound to grant and observe: Protection from competition, both municipal and private; rates that will insure full cost of operation after taking into consideration all the elements that enter into the cost of the business and that will in addition return a reasonable profit on its value as a going concern, taking into consideration the vicissitudes of the business, and franchises that will insure to capital invested continuous safety and be free from political bartering or the attacks of the demagogue.

Franchises have been stock in trade of the political agitator and demagogue for more than a decade. They

have been represented as of great value, but they generally turn out less valuable than they look. "Franchises are like babies. We have to have them to keep the world going. But they are generally not worth much when they come, and you have to spend lots of money on them to develop them, and when you get them to be profitable they are gone." We must have a franchise to operate, but there cannot be much inducement for the investment of sufficient capital to give good service or reasonable rates with short-term franchises subject to the onslaught of the agitator, demagogue and boodler when they must be renewed. Mr. Gaskill expressed his own opinion that the franchise should have no term at all, but should be granted by the state through the public service board, and be irrevocable and protected from competition, both municipal and private, so long as the utility gives good service and reasonable rates and carries out the orders of the public service board. If such board has control of the rates and the service of the utility, the public need have no fear of the results of such power.

In the discussion Mr. J. C. Martin, Wilmington, pointed out that the desire for a utility commission came from the corporations as well as the public, and the passage of the act has resulted in an influx of capital into the State. Mr. J. V. Oxtoby, attorney for the Detroit Edison Company, expressed hope that other legislatures might take cognizance of the broad principles applied by the Wisconsin commission. A franchise, contrary to the general opinion, he said, has no value. For if it does not fix rates it is merely a permit sustaining the maintenance of company equipment in the city streets. Matters of rates and franchises are not properly matters of "home rule," since state bodies benefit and advance from each successive case, while the local community is limited to only a single experience.

COMMITTEE ON COSTS.

At the session of Thursday morning Mr. J. D. Lyon, Cincinnati, chairman, read the report of the committee on costs. It enumerated the various items which make up investment expense, operating costs, cost of going value, depreciation, diversity-factor, etc., listing under each heading the various subjects properly attributable to the corresponding charge. Under the heading of diversity-factor was included a discussion of the application of this factor to rate schedules. From data obtainable, although admittedly meager, the committee's report pointed out the interesting conclusion that the curve of diversity-factor as affected by load-factor or the equivalent hours' use of maximum demand is exponential and probably of the hyperbolic form.

Mr. D. L. Gaskill, Greenville, suggested extension of the committee's work to rates and accounting, also giving its assistance to the utility commission in reaching a basis of standard accounts for central stations. Mr. W. C. Anderson, Canton, observed that the forty-dollar demand charge per kw-year, regarded as permissible by the Wisconsin commission, does not exceed the standby connection charge made in many Ohio plants. Mr. J. C. Martin, Wilmington, declared each company should know its own costs. Replying to Mr. F. C. Jeannot's inquiry, Mr. Lyon explained the method of computing the fixed charge of daily delivered capacity. This amounts to 11 cents per kw-day in the case of a charge of $40 per year, but in actual use is generally found to be higher, being from 15 to 22 cents per day.

N. E. L. A. AFFILIATION.

Mr. F. M. Tait, Dayton, president of the National Electric Light Association, spoke briefly on the subject of affiliating the Ohio association with the national body and asked for a committee to investigate the advantages of such membership, a constitutional change being necessary. President Anderson later appointed Messrs. Mathias Turner, Cleveland; W. P. Hubbell, Wauseon, and D. L. Gaskill, Greenville, members of the committee on N. E. L. A. affiliation.

REPORT OF METER COMMITTEE.

The report of the meter committee, comprising Messrs. John Gilmartin, Toledo; H. L. Cook, Columbus, and J. T. Kermode, Cleveland, was presented by Chairman Gilmartin. In large part the report was devoted to a discussion of the meter problems before the small companies. Meter accuracy as an important factor in the company's revenue was mentioned under this head, and methods were described for use by central stations having less than 1500 meters. Periods between tests for different classes of meters were defined. The report also recommended meetings of meter men from the companies of the State, devoting in each case an entire day's session to the conference.

In the discussion Mr. W. Parsons, Springfield, said that "the meter is the cash register" of the plant and deserves the best care and attention. He also urged a reduction in the shunt losses per meter, which now vary from 2.2 watts to 16 watts. Mr. H. L. Cook, Columbus, recommended the N. E. L. A. meterman's handbook as a valuable work for its purpose. Prof. F. C. Caldwell, Columbus, referred to plans now maturing to make the electrical laboratory of the Ohio State University a state branch of the National Bureau of Standards for the testing of instruments. He also offered the services of graduate and undergraduate students at nominal rates for meter-testing work. A suggestion made by Mr. J. C. Martin, advocating the state testing and sealing of all meters, was objected to by Messrs. R. S. Graves, Cincinnati; A. S. Yard, Newark; F. C. Jeannot, Marysville; W. Parsons, Springfield; H. L. Cook, Columbus; John Gilmartin, Toledo; J. T. Kermode, Cleveland, and W. C. Anderson, who pointed out its practical disadvantages in loss of time, increased stock of meters, impossibility of repairs, etc. Mr. E. C. Burch, East Liverpool, said that 70 per cent of his meter complaints when traced down were found to be unjust, so that it has been found less expensive to send a solicitor to the customer to discuss the matter with him and convince him of his error than to take the time of a meterman. Mr. Kermode observed that closer scrutiny would likely reveal that 95 per cent of these complaints were unjust. Of those justified, perhaps 2 per cent will be due to grounds. He discouraged the practice of sending a solicitor to discuss troubles with customers.

ELECTROLYTIC PURIFICATION OF SEWAGE.

Prof. F. C. Caldwell, of Ohio State University, Columbus, next presented a report on the electrolytic purification of sewage, on which principle plants are now operating at Santa Monica, Cal., and Oklahoma City, Okla. After outlining the method of destroying the various putrefying, oxidizing and disease-producing bacteria by the passage of electric current, the speaker described the Oklahoma City plant, an illustrated description of which was given in the *Electrical World* of May 4, 1911. While the evidence seems quite conclusive that where the sewage has received suitable disintegrating and digesting or putrefying action previous to the electrolytic treatment the effluent immediately after each treatment is practically odorless and free from bacteria, the author added that the question which does not seem to be satisfactorily answered is "Has organic matter been so far oxidized that it can be relied upon not to putrefy again and thus develop a nuisance in the stream through which it flows?"

Professor Caldwell also pointed out that the means of disposing of the effluent in the two cases cited is not usually at hand in most sections of the country. The cost of operating the Oklahoma plant, which cost $16,000, is said to be $3,500 a year, or $12.81 per 1,000,000 gal. The author deplored the fact that no conclusive report by a competent and experienced sanitary engineer is available on the plants

now running, although the identical system was first experimented with by Webster in England in 1889. Trenton, N. J., he mentioned, is now installing an ozone plant for sewage purification. In conclusion, said Professor Caldwell, it appears that the verdict for the electrolytic purification of sewage must at the present time be "Not proven, but very interesting." The paper was discussed briefly by Messrs. J. D. Lyon, Cincinnati, and G. McQuilkin, Canton.

ELECTRICITY IN RURAL DISTRICTS.

In his paper on the use of electricity on the farm, Mr. J. C. Matthieu, Dayton, explained that many Ohio truck farms depend on proper and seasonable rainfall for their success. Such crops require the even distribution of from 1 in. to 5 in. of water per month, while more is desirable. In six months, however, hardly 3 in. falls in Ohio, this precipitation often occurring in excessive rains followed by droughts.

Experience has shown crop increases of 25 to 100 per cent with plentiful wetting of the ground at plant setting and regularly applied irrigation of 2 in. to 3 in. of water per week in from one to three applications, depending on the weather and the extent of natural rainfall. Artificial irrigation thus enables the gardener to force a rapid yield, as vegetables may be set or transplanted without waiting a fortnight or more for natural moistening of the ground.

The sprinkling method is chiefly used by the truck gardener. Water is supplied to the soil by nozzles attached to a movable section of pipe. The pipes are placed 60 ft. apart and are from 3 ft. to 10 ft. above the ground, permitting an unhampered cultivation of the soil. The main pipe, 2 in. to 4 in. in diameter, is usually laid across the field below the frost level.

In some instances motors are used to increase the circulation of the water in the heating pipes in greenhouses, the result being a saving in the coal bill. The centrifugal pump is the most popular. That the pump can be left running without an attendant appeals to the farmer. One 10-hp motor can be used on the farm as the general-utility motor, driving feed grinders, hay presses, silage grinders, threshers, corn shellers and refrigerating machinery. There are also many duties which could be performed about the farm after dark if the farmer had the proper light. The probable consumption of the motor on the farm would be 200 kw-hr. per month.

Discussion.

Mr. S. M. Rust reported the farmers along the Greenville lines to be good paying customers. Mr. W. C. Anderson, Canton, pointed out that the increasing number of splendid homes in the country should make rural lines more profitable. Mr. J. C. Martin, Wilmington, expressed his opinion that central-station service can hardly compete with farm isolated plants, which, he said, can be operated at a cost only a few cents a day more than that necessary for the pumping. Mr. W. R. Griffen, East Liverpool, testified, however, to converting many farmers from isolated-plant to central-station service from his 13,000-volt distribution line. Mr. C. I. Crippen, Youngstown, also reported shutting down isolated farm plants. The income from this farm service, he said, averages $20 per year. Meters are read quarterly, but a plan is now to be tried to have the customers read their own meters and report their consumption.

Mr. Reinhart spoke of the extensive rural development around Marion, Ind., where it is planned to supply energy to threshing machines over temporary lines borne on A-frame poles. Mr. M. H. Wagner, Dayton, cited a case where a farmer saved 50 per cent by replacing his plant with purchased energy. Mr. Rust told of a farmer who had bought a gas engine and storage battery for $500 and is now clamoring for service connection. Mr. S. H. Bruce declared isolated plants to be benefits, since they are the cause of getting houses and barns wired, accustoming the farmer to the conveniences of electricity. Soon he learns also of the unreliability of his little plant and then is ready for central-station service. Mr. Chappelle insisted that with gas-engine plants and storage batteries farmers can obtain electricity at 3 cents per kw-hr., a rate, he said, lower than the central station can supply it.

JOINT POLE-LINE CONSTRUCTION.

The closing feature of the program was the report by the committee on joint pole-line construction, presented by Mr. J. L. Spore, Toledo. Such construction relieves the city street from the cluttering due to several sets of poles, insures more rigid poles as well as more frequent inspection by different sets of men, and decreases the initial cost and maintenance expense. The pole agreement entered into by the nine companies operating in Los Angeles, Cal., was abstracted in the report, which was illustrated with photographs and sketches showing the conditions described. In the discussion Mr. W. Parsons, Springfield, told of the satisfactory agreement reached between his company and the Bell telephone company at Springfield. When the telephone company has a line the electric company can secure joint use of the poles, if they are high enough for its purpose, by paying one-half the cost. If not high enough, the electric company erects taller poles, which become the telephone company's property, while the old poles are taken by the electric company. The electric light company then maintains the new poles, furnishing free contacts for telephone use. After brief discussion by Messrs. O. B. Welsh, W. J. Conrad, W. C. Anderson, C. I. Crippen and H. M. Wagner, it was voted to have the Springfield agreement abstracted for printing in the convention transactions.

ACTIVITY IN COAL-MINING AND ELECTRIC-SERVICE PROPERTIES IN CENTRAL ILLINOIS.

Sensational reports about the merger of coal-mining and electric-service properties in Central Illinois, with electrical energy transmission to Chicago, have appeared in many of the daily newspapers. Inquiry reveals the fact that there is considerable activity in the area mentioned, in the consolidation both of coal mines and small central-station properties, and there may be some connection between these two developments going on at the same time. However, the reports about the long-distance transmission of energy from the coal mines to Chicago, a distance of from 150 to 200 miles, according to the location of the mines, are not based on facts, so far as can be ascertained at the present time. Furthermore, the two-hundred-million-dollar corporation spoken of in some of the news dispatches has not materialized as yet, while it is believed also that the report of the merger of nearly all the public-service plants in the State is very greatly exaggerated.

However, developments in central Illinois, so far as publicly known, are of an interesting nature. Mr. F. S. Peabody, of Chicago, a prominent coal-mine operator, owns several coke mines and tracts of coal lands in Christian County and nearby counties in central Illinois. One of his tracts of coal land is at Kincaid, where he has 780 acres. On this tract Mr. Peabody plans to develop a coal mine and build an electric generating station to be operated by the coal from the mine. The initial rating of this generating station will be about 2000 kw. Electrical energy from this station will be used to operate the hoisting and other machinery in Mr. Peabody's mines and also perhaps in a number of other mines on which he has options and which he may purchase. This will give the plant a considerable day load, but in order to operate the plant more economically and give it a desirable load-curve Mr. Pea-

body has purchased several small central-station plants, notably in Edinburg, Pawnee, Auburn and Nokomis, which are small towns in Christian, Sangamon and Montgomery Counties. This is the nucleus of what may possibly develop into a much larger project as time goes on.

At the same time the Central Illinois Public Service Company of Mattoon, Ill., is extending its field of operations and reaching out into the surrounding territory, which is not very far from the scene of Mr. Peabody's operations. Possibly there is some connection between these two activities, as the Central Illinois company is reported to have bought some small central-station properties recently. Mr. Samuel Insull, president of the Commonwealth Edison Company of Chicago and of several other public-utility companies, has been mentioned in connection with the central Illinois situation. He denies, however, that he will enter the coal business or is about to form a mammoth combination to embrace all the principal coal mines and central-station properties of the State of Illinois.

It is of interest to add that on July 29 the authorized capital of the Central Illinois Public Service Company was increased from $330,000 to $6,000,000.

PROVINCE OF ONTARIO WINS SUIT AGAINST CANADIAN NIAGARA POWER COMPANY.

The Privy Council of England has decided that the construction placed upon the contract between the Province of Ontario and the Canadian Niagara Power Company by the Attorney-General of Ontario is the correct one, thus reversing two judgments given in Ontario courts in favor of the power company. The result will be the payment into the provincial treasury of many thousands of dollars, being the amount of money due for the right to utilize the water of the Niagara River over and above the amount heretofore annually paid by the company. The unpaid amount reaches these large proportions because the contract has been in force for ten years and payment has been made according to the company's interpretation of it. The contract which gave the company rights for the manufacture and sale of electrical energy provided for a given method of computing the rental charge fixed by the government. This, the company maintained, was based on a meter charge. The Province contended that the rental ought to be based upon the peak or maximum load. The difference between the rentals computed on that basis, on one hand, and on the basis of average load, on the other, is considerable and corresponds to a sum of money which the Privy Council holds is due the Province. The case was first taken to High Court by the Attorney-General in 1908, when Mr. Justice Riddell decided in favor of the defendants. On appeal by the Province to the Court of Appeal, this decision was upheld, two judges, however, dissenting. The argument before the Privy Council was heard three weeks ago, and judgment was reserved until July 22. The phraseology on the point in dispute is as follows:

"Peak Contract.—Payment is made for the greatest actual capacity in horse-power recorded at any one time. This record governs any period for which payment is being made and may also govern the remainder of the contractual period. The computation may be made progressively from the date of the record or such record may also have a retroactive effect.

"The peak or maximum horse-power is nothing more or less than the real capacity, demonstrated to have been required, and is that which contains the greatest number of units of horse-power, so that payment for each horse-power is, of course, payment for the maximum horse-power.

"Meter contract payment is made for the number of horse-power hours or average horse-power, the standard of measurement being a compound or integration of capacity and time. The number of horse-power hours or average horse-power is ascertained by readings indicated by a meter, which are averaged by an integrating meter, which compounds or integrates capacity and gives the result in horse-power hours."

HEARINGS ON BROOKLYN CENTRAL-STATION RATES.

At the last hearing on Brooklyn central-station rates, in relation to the complaint of certain consumers announced in our last issue, it was argued for the complainants that small individual consumers are not receiving the same proportionate benefits as large or wholesale consumers. The Bush Terminal, which it was declared enjoys a rate of less than 2 cents per kw-hr. and resells energy to its tenants at a 3-cent rate, was cited as an illustration. Many small customers pay a rate of 11 cents.

Vice-president W. W. Freeman of the Edison Electric Illuminating Company of Brooklyn stated at some length the company's attitude in the matter. The more signficant portion of his statement follows:

"The company asserts that its rates now, as in the past, are just and reasonable, and that the earnings of the company are substantially less than the minimum return upon actual property values that has been allowed by the commission in the recent rate cases. The property of the company is fully equal in present value to the amount of its outstanding securities. Its service, in point of reliability and quality, is not surpassed in any city throughout the world.

"The rates for service have been reduced voluntarily and frequently as applied to all classes of service and as rapidly as conditions of growth and proper development would warrant. The last reduction was put into effect on July 1, 1912, and involves a loss in revenue estimated at $250,000 annually. This reduction affects the great mass of the company's customers and automatically lowers the price of service as the average use of the consumer increases.

"In addition to rate reductions, the company has voluntarily extended to the public the full and enormous advantages of the improvements in incandescent lamps whereby the amount of light obtained for the same money has been more than doubled.

"In 1905, after the Legislature had fixed the maximum rates for electricity, the cost of burning a standard 16-cp lamp for 1000 hours at retail rate in Brooklyn was $6. Now, with the use of the Mazda lamp and present retail rate, the same amount of light can be secured for $2.53, including the cost of the lamp. The company has been operated with a constant desire to serve the public well."

PUBLIC SERVICE COMMISSION NEWS

NEW YORK COMMISSION, FIRST DISTRICT.

Wednesday, July 31, was the first anniversary of the beginning of work on the Lexington Avenue subway. In the year which has elapsed great progress has been made on this line, which will be the backbone of the new subway system. From the report of Alfred Craven, chief engineer of the Public Service Commission, on the progress of work for the month ending July 15, it appears that contracts have been let by the commission for twelve of the sixteen sections of this line, aggregating 41,407 ft. in length, or about 8 miles, at contract prices totaling $35,521,291.19.

NEW YORK COMMISSION, SECOND DISTRICT.

The commission has denied the application of the Lewiston & Lake Ontario Shore Power Company to exercise

franchises in the town and village of Wilson, Niagara County, for the reason that the Conant-Bryant Power Company is at present doing business in the village of Wilson and also has a franchise from the town of Wilson. The Lewiston & Lake Ontario company, however, is given permission to renew its application if the Conant-Bryant Power Company shall not present to the commission, at a hearing to be held at Buffalo on Aug. 2, proof that it has entered into a contract with the Niagara, Lockport & Ontario Power Company for the purchase of Niagara energy so that it will be able to supply any demand in the town and village of Wilson, and proof, furthermore, that the power company has actually begun the construction of its transmission line to Wilson, and that the Conant-Bryant company has begun work upon its transmission line in the town of Wilson.

MASSACHUSETTS COMMISSION.

The Gas and Electric Light Commission has approved the consolidation of the Chicopee Gas Light Company with the Springfield Gas Light Company, and has authorized the issue by the latter of 1110 shares of additional stock of the par value of $100 each and the exchange of the same for the entire capital stock of the Chicopee company upon the basis of one share of Springfield stock for two shares of Chicopee stock. An interesting phase of the case is the question of prices to be charged in Chicopee as a result of the consolidation. The plants in the adjoining cities of Springfield and Holyoke have enjoyed a volume of business several times that of the Chicopee company and have been able, on account of the great difference in their circumstances, to sell gas profitably at a much lower price than a company like that in Chicopee can be reasonably expected to do. The mains of the two companies have lately been operated as integral parts of one system under the same financial control. The municipal authorities of Chicopee objected to the consolidation unless the Springfield company would immediately establish the price of gas at 85 cents in Chicopee, as elsewhere in its territory, although the former Chicopee price was $1.25 and it was the intention to make a reduction to $1.15 net immediately after consolidation. The board says: "The question of price is involved in this proceeding, not perhaps primarily but incidentally to the question of the expediency of a union of the two companies. From an examination of its annual return it is difficult to see how the Chicopee company, if it remains independent, can be required to sell at less than the price now charged. The proposed consolidation will give an obvious advantage to consumers in Chicopee even if the reduction from present rates be no greater than was offered at the hearing. If, however, the company can make a price still lower without prejudice to the interests of its other customers it may properly be asked to do so. In other words, the Chicopee consumers are entitled immediately upon consolidation to the lowest reasonable price which the company can make. In fixing such rate many different conditions must be considered. While the board has been unable to consider all the pertinent facts with the same thoroughness as might be done if a reduction in price were the only issue involved, it is of the opinion that the company may be reasonably asked to reduce its net price immediately upon consolidation to consumers in Chicopee to $1 per 1000 ft. While this price may be reasonable for a limited period, it would be entirely unreasonable as a permanent differential. The benefits accruing from such a consolidation are seldom realized immediately, but are progressive in their character. If, beginning with the price named, further reductions are made as conditions permit, the interests of all consumers will be promoted and in due time a uniform price will undoubtedly be established throughout the entire territory covered by the united company."

OHIO COMMISSION.

Although the Ohio Public Service Commission had refused the application of the Columbus, Kenton & Toledo Traction Company to issue bonds because the price at which it was desired to sell these securities was considered too low, the commission on July 27 granted permission to the traction company to issue $1,385,000 par value of bonds to be sold at 80 or above and $50,000 of stock to be sold at par. The commission became convinced that under present market conditions the bonds could not be sold for as high a figure as 95 or 100. The company was exceptionally anxious to commence construction.

WISCONSIN COMMISSION.

During the past week decisions on two minor cases were issued by the Wisconsin Railroad Commission. The village of Whitehall was authorized to increase its rates for street lighting from 25 cents per lamp per month to 40 cents and to increase the rate for commercial lighting, which now ranges from 3 cents to 8 cents, to 6 cents per kw-hr. The petition of the Bruce Water & Light Company for authority to increase the motor-service rates was not granted, but the immediate results desired by the petitioner were effected by means of a re-classification of the motor users. The commission also called attention to the fact that the present practice of discriminating in the amount of the minimum bill between those consumers who own their own meters and those who do not is contrary to law and ordered that steps be taken to remove the illegal features of the schedule.

Current News and Notes.

ALEXANDER WIRELESS BILL.—The Alexander wireless-telegraph bill, which has been under consideration by the House of Representatives, was recently stricken from the calendar, and there is little probability that it will pass during the present session of Congress. Representative Mann objected to a consideration of the subject at this time on the ground that it requires more study and further consideration before taking final action. The government is said to be especially anxious to secure a broad law which will secure relief from interference with wireless communication by the numerous amateurs.

* * *

THIRTY YEARS OF EDISON SERVICE IN NEW YORK.—The month of September will complete the thirtieth consecutive year in which Edison service has been available in New York City. This means that, with the exception of four days of partial interruption resulting from a fire in the old Pearl Street station many years ago, direct-current service has been continuously at the disposal of the New York public throughout that entire period. The anniversary will be celebrated through the medium of the Electrical Exposition and Automobile Show, which will be held in the New Grand Central Palace, New York, Oct. 9-19, 1912.

* * *

INDUSTRIAL SERVICE BUILDING IN BALTIMORE.—As an aid in the development of the resources of the community it serves, the Consolidated Gas, Electric Light & Power Company, Baltimore, has caused to be erected a building for providing every requirement of small manufacturers without capital expenditure. The company guaranteed one-half of the cost of the building, the result being the formation of a $300,000 company and the erection of a seven-story and basement steel and concrete building. This building was formally opened on July 24, the principal speaker on the occasion being Mr. J. E. Aldred, president of the Consolidated Gas, Electric Light & Power Company.

Riverside (Cal.) Municipal Plant.—According to a report made to the city clerk, the revenues of the municipal electric plant of Riverside, Cal., increased 83 per cent in the year ended June 30, 1912, compared with the preceding year. The principal gain was in the sale of electricity for industrial purposes, although there was a 12 per cent increase in the revenue from lighting customers, now amounting to about 4000.

* * *

Wireless-Telegraph Operators to Form Union.—At a meeting held recently in Hoboken, N. J., by representatives of wireless-telegraph operators of America, England, Germany, Belgium and other countries measures were adopted for the formation of a world-wide union of wireless operators. Those in charge of the movement report that temporary headquarters have been established at 50 Broadway, New York City.

* * *

Violet Ray Sterilization of Drinking Water.—A plant for the sterilization of 150 gal. per hour of Lake Michigan water by violet rays has been in operation in Chicago since March 14, 1912. The water is bottled for drinking purposes. In brief the process consists of coagulation, sedimentation, double filtration and sterilization by means of violet rays emitted from a Cooper Hewitt quartz-tube mercury-vapor lamp. The lamp in use is rated at 4.5 amp, 110 volts. As a sanitary precaution the cooler or porcelain jar in the office of the consumer receives a periodic cleansing and sterilization by a portable violet-ray lamp which is placed over the jar for five minutes, the energy being taken from any convenient electric lamp circuit.

* * *

Interstate Industrial Commission Recommended.—In a report signed by three members of the steel investigating committee of the House of Representatives a recommendation was presented favoring the creation of an Interstate Industrial Commission empowered to regulate industrial corporations doing an interstate business and authorized to fix reasonable prices for the output of these concerns. It is proposed that all corporations exceeding $50,000,000 in capitalization or valuation must be incorporated under a federal act before engaging in interstate commerce. It is also proposed that all such corporations must be capitalized at their actual value. Interlocking directorates and holding companies would be forbidden except when permitted by the Interstate Commission of Industry.

* * *

Opposition to Grants of Water-Power Rights.—According to recent reports, Representative Henry T. Rainey, of Carrollton, Ill., has killed six bills introduced in the House of Representatives at Washington and intended to grant water-power rights on navigable streams to corporations and individuals. The main ground of opposition to these bills appears to be that they did not provide compensation for the government. One of the bills was introduced by Representative I. S. Pepper, of Muscatine, Iowa, and was designed to authorize the Great Northern Development Company to build a power dam across the Mississippi River between Davenport, Iowa, and Rock Island, Ill. All of the bills are said to have had the approval of army engineers and to have been reported favorably by the committee on interstate and foreign commerce. They were objected to, however, by Mr. Stimson, the Secretary of War, partly because they did not comply with the recent recommendations of the National Waterways Commission.

* * *

Decision Against St. Louis Central-Station Merger.—The United States Circuit Court of Appeals for the Eighth District has filed a decision in the case of Morgan Jones and others against the Missouri Edison Electric Company, which has been in the courts nine years. The plaintiffs, who were stockholders in the Missouri Edison Company, sought to have set aside and declared illegal the consolidation of that company with the Union Electric Light & Power Company, of St. Louis, which was effected in September, 1903, alleging that the minority stockholders were not allowed a proper amount of stock in the new company. The court held that the distribution of stock in the new company to the stockholders of the Missouri Edison Company was grossly unjust, and the case was remanded to the lower court with instructions to ascertain the valuation of the new company and assign to the appellants the proportion of stock to which they are entitled, unless the defendants in the meantime are willing to pay over the value of this stock, with interest, and the costs of the suit.

* * *

Chamber of Commerce of the United States of America.—A pamphlet describing the plan of organization and general purposes of the Chamber of Commerce of the United States of America has recently been distributed from the headquarters in Washington, D. C. This body was formally organized at the National Commercial Conference called by the President of the United States and held in Washington, D. C., on April 22 and 23. The purpose of this body is to encourage and promote the organization of associations of business men in all parts of the country, and to encourage co-operation among such organizations and increase their efficiency. It is also the intention to study the work performed by all government bureaus which are related in any way to the commerce of the country, and to analyze carefully all statistics relating to the production and distribution of all manufactured products, at home and abroad. Attention will also be given to legislation affecting business and trade. Every commercial or manufacturers' association not organized for private purposes is eligible for membership. Standing committees will be appointed by the board of directors on membership qualifications, domestic commerce, foreign commerce and traffic, transportation and communication. The headquarters of the organization are in the Riggs Building, Washington, D. C.

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SOCIETY MEETINGS.

Radio-Engineers' Meeting.—The next meeting of the Institute of Radio-Engineers will be held at Columbia University on Monday, Sept. 2, 1912. Mr. E. J. Simon, 81 New Street, New York, is its secretary.

* * *

Annual Meeting of Sons of Jove.—The next annual meeting of the Order of Rejuvenated Sons of Jove will be held at Pittsburgh, the home of the reigning Jupiter, Mr. Robert L. Jaynes, beginning on Oct. 15 and continuing four days. The Fort Pitt Hotel will be official headquarters.

* * *

Iron and Steel Electrical Engineers.—A change has been made in the date of the annual meeting of the Association of Iron and Steel Electrical Engineers. It had been announced to take place Sept. 16 to 21, but will be held from Sept. 23 to 28 in Milwaukee, Wis., with headquarters at the Hotel Pfister. Mr. James Farrington, Steubenville, Ohio, is the secretary of the association.

* * *

International Association for Testing Materials.—Further information concerning the approaching sixth congress of the International Association for Testing Materials, announcements of which have already been made, is given in Bulletin No. 3, dated July, 1912, which supersedes all previous bulletins. Appendix I of the bulletin gives a list of the official delegates, and Appendix II contains abstracts of the American papers. The secretary is Mr. H. J. F. Porter, 29 West Thirty-ninth Street, New York.

CANADIAN HYDROELECTRIC DEVELOPMENTS

Low-Head Generating Station of the Canadian Light & Power Company on the Beauharnois Canal at St. Timothee, Quebec.

Energy Transmitted 27 Miles at 44,000 Volts Over Steel Tower Line to Montreal Terminal Station and Auxiliary Steam-Turbine Plant on the Lachine Canal at Montreal.

SKIRTING the south side of the St. Lawrence River for a distance of about 11 miles, connecting Lakes St. Louis and St. Francis and forming a navigable highway around the Coteau and Cedar Rapids, is the Beauharnois Canal. Since the opening of the Soulanges Canal on the opposite bank of the St. Lawrence River in 1900, the Beauharnois Canal has been practically abandoned for navigation purposes. The Canadian Light & Power Company has leased the power rights from the Dominion government and has erected a station at St. Timothée, a village facing the Coteau Rapids of the St. Lawrence and about 27 miles west of Montreal.

FOREBAY.

The canal at this point is about 2000 ft. from the river, and in order to avoid long penstocks the company threw up two 2000-ft. earth embankments, 700 ft. apart and 40 ft. high, thus forming a forebay from the canal to the banks of the river. On the river side of the forebay a head-wall was erected in conjunction with the power house and spillway, the latter being arranged to pass drift-wood and ice into the St. Lawrence River. The head-wall, which is built of concrete, is 430 ft. long, 50 ft. high and 82 ft. wide at the base. A 32-ft. spillway is provided at one end, and the dam itself is composed of a series of twenty-two bays, each main penstock being connected directly with two bays. Stop-log grooves are provided on the upstream side of the racks in addition to timber flap gates across each half opening to the penstock. These gates differ somewhat from the ordinary in that they are hinged at the bottom and are provided with concrete counter-weights at the top to keep them open under normal conditions. Provision is made for removing ice formations from the penstock bays and passing the ice along the head-wall to the spillway. The flow of water is sufficient to prevent the formation of anchor ice in the tailrace, and no difficulty is experienced from ice in the river piling up and reducing the head, since Cedar Rapids is just below the tailrace and the flow of the St. Lawrence River at that point is very strong.

HEADWORKS.

In order to provide sufficient water for the development it was necessary to enlarge the canal and to erect suitable headworks at its intake from Lake St. Francis, which is about 6 miles from the power-house site. A boat gate was installed to take the place of the former guard lock, and in addition four huge steel Tainter gates were erected to control the flow from the lake at Valleyfield. The work of enlarging the canal and constructing the intake and controlling works was begun in the spring of 1910, and the forebay, intake, etc., were completed for the full development of 75,000 hp, although 22,950 hp is all that will be utilized at present. The generating station was placed in operation last fall.

POWER HOUSE.

The power house, which adjoins the head-wall, is only partially completed, provision being made for four units. There are false walls at either end so that the station may be extended both ways when desired. Water passes from the head-wall through steel penstocks 14 ft. in diameter, each connecting the penstock bays in a horizontal line with the wheel chambers, the distance from the intakes to the center of the surge tank being 64 ft. and the penstocks flaring out to the diameter of the tank as shown. Here again the construction is somewhat out of the ordinary in that surge tanks within the station contain the main units. These tanks, which are 27 ft. in diameter and 59 ft. high, are made of riveted steel plates and are open at the top. From the center of the wheel shaft to the top of the tank is 49 ft. In each tank are placed two 72-in. turbines on a single shaft. The machines were built by the S. Morgan Smith Company, of York, Pa., and each pair develops 7500 hp when operating under a 50-ft. head at a speed of 150 r.p.m. The entire weight of the turbines and of the water load is carried on two bearings located outside the tank, where they are readily accessible for inspection and repair. The turbine gates are regulated by Lombard governors, capable of effecting complete closure within three seconds if necessary. The draft tubes leading from the wheels to the tailrace are of concrete.

GENERATING EQUIPMENT.

The present generating equipment consists of three 5000-kva Allis-Chalmers-Bullock three-phase generators, wound for 2300 volts, 60 cycles, and operating at a speed of 150 r.p.m. There is nothing special about the design of the machines except the construction of the rotor. The latter consists of a cast-steel spider, to which is dovetailed a rim composed of thin sheet-steel laminations. The laminations are arranged in such a way that there is a joint only at every sixth sheet. The rim was built up and bolted together by loose-fitting bolts, which were later removed one at a time to permit the reaming of the holes for tightly fitting bolts. Laminated pole pieces are dovetailed to the rim, the latter being designed to take all of the stress due to centrifugal force, while the cast-steel spider simply serves to center the rim. The rotor is designed to withstand an overspeed test 100 per cent above the normal. It might be mentioned in this connection that all of the electrical apparatus

in the St. Timothée station was built by the Allis-Chalmers-Bullock Company, Limited, in Montreal, and designed by Mr. B. T. McCormick.

The exciter plant consists of two waterwheel-driven machines, rated at 200 kw each, in addition to a 60-kw booster set, which is designed to operate in series with the exciters and with a 100-cell storage battery in such a way

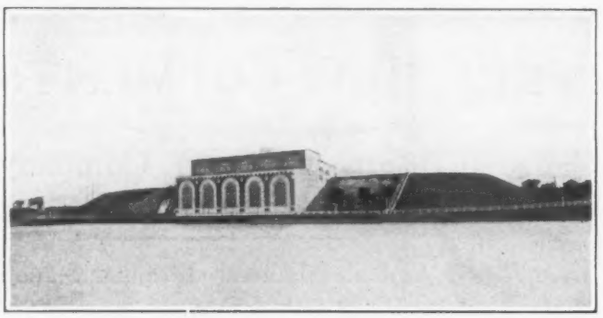


Fig. 1—Station of Canadian Light & Power Company from River.

that all excitation normally flows through the booster, which acts as a regulator. Thus, if a circuit-breaker on an exciter opens for any reason the battery will furnish excitation energy, since it is still connected with the circuit, being

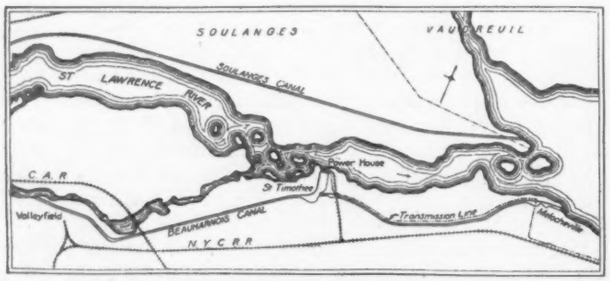


Fig. 2—Map Showing Location of Power House.

in parallel with the exciter unit. If the booster stops for any reason an automatic circuit-breaker opens and the battery supplies the excitation energy directly. The booster consists of a 60-kw, 60-volt direct-current generator, driven by a 100-hp, 220-volt, 850-r.p.m. motor. The generator is designed to operate on all voltages from zero to maximum with current flowing in the armature in either direction, and is provided with a special reversing shunt field rheostat. A shaft oscillator and an automatic overspeed device which trips the circuit-breaker in the motor circuit in case of excessive speeds are also installed. There is a common negative exciter bus in the basement of the generating room, and two positive buses are provided with a difference of potential of 30 volts maintained between them.

TRANSFORMERS.

Three transformers, rated at 5000 kva, three-phase, 60-cycle, step up the potential from 2300 to 48,000 volts.

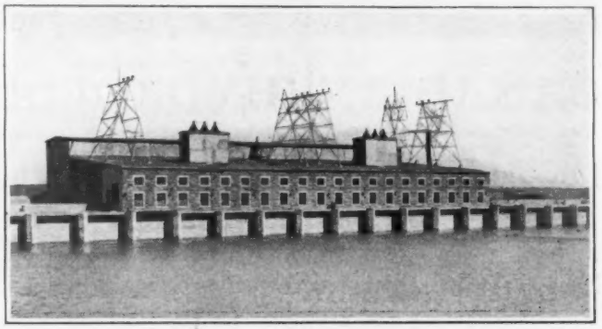


Fig. 4—View of Station at St. Timothée from Forebay.

The transformers are oil-insulated and water-cooled and are connected in delta on both the high and the low-tension sides. Taps permit tensions of 42,000, 44,000 and 46,000 volts to be obtained. The construction of transformers is such that they may be lifted out of the cases by means of an eye-bolt in the cover, and each is provided with an emergency oil drain leading to the tailrace. The transformers are protected against short-circuits within themselves by means of series instrument transformers in the high-tension and low-tension windings connected in opposition and operating in conjunction with an overload relay, which trips if the current in the transformer is unbalanced, and thus switches the transformer out of circuit.

CONTROL.

The control board is located in a glass-inclosed switchboard gallery overlooking the generating room. The equipment comprises direct-current exciter and battery panels, relay panels and a bench-board control desk, with a mimic diagram of the main circuit from the generators to the outgoing lines. Above the benchboard, facing the operator, is an instrument rack bearing the regulation meters and a pyrometer connected to a resistance coil in a slot of the generator by means of which the temperature of the machine may be ascertained. The overload capacity of a generator being limited by the temperature of the windings, it is possible with this connection available to watch the pyrometer instead of the wattmeter to determine if the machine is overloaded or not.

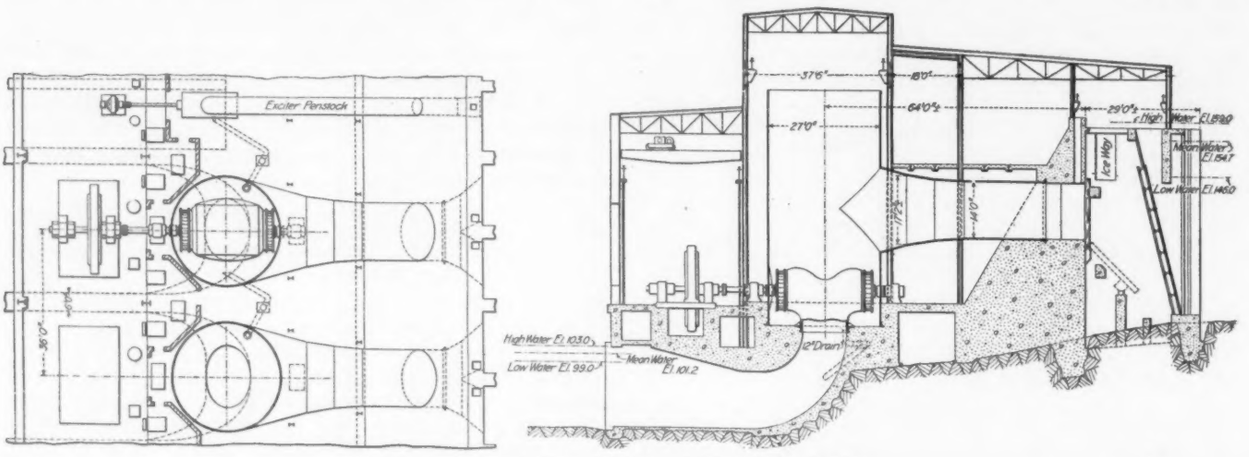


Fig. 3—Plan and Cross-Section of Generating Station.

A transfer bus inclosed in a brick compartment is carried in the penstock room the full length of the station. Underneath this transfer bus is a set of auxiliary buses for each unit, and a tie bus in the center of the system connects the auxiliary with the common bus. The disconnecting switches are all provided with locking attachments. A manually operated signal snap switch indicates, by means of a bull's-eye lamp, when these switches are open or closed. The relay board in the switchboard gallery is fitted with testing jacks, so that by simple plugging in any tests may be made without interruption on meters, relays, instrument transformers, etc., while the plant is in operation. The field rheostat and the field switches are electrically operated from the benchboard. The switch equipment is of Westinghouse manufacture.

operator may indicate to the switchboard operator by means of the lamp in the indicator on the benchboard that the particular order has been carried out.

TRANSMISSION LINE.

A steel tower transmission line runs from the power house to the terminal station in Montreal over a private right-of-way to the Beauharnois Canal, the north bank of which is followed as far as Melocheville, where the line turns and parallels the New York Central Railroad as far as the Canadian Pacific bridge across the St. Lawrence River. The river is crossed in two long spans and the line continues to the Lachine Canal at Rockfield, thence following the north bank of the canal to Côte St. Paul, where the terminal station is located.

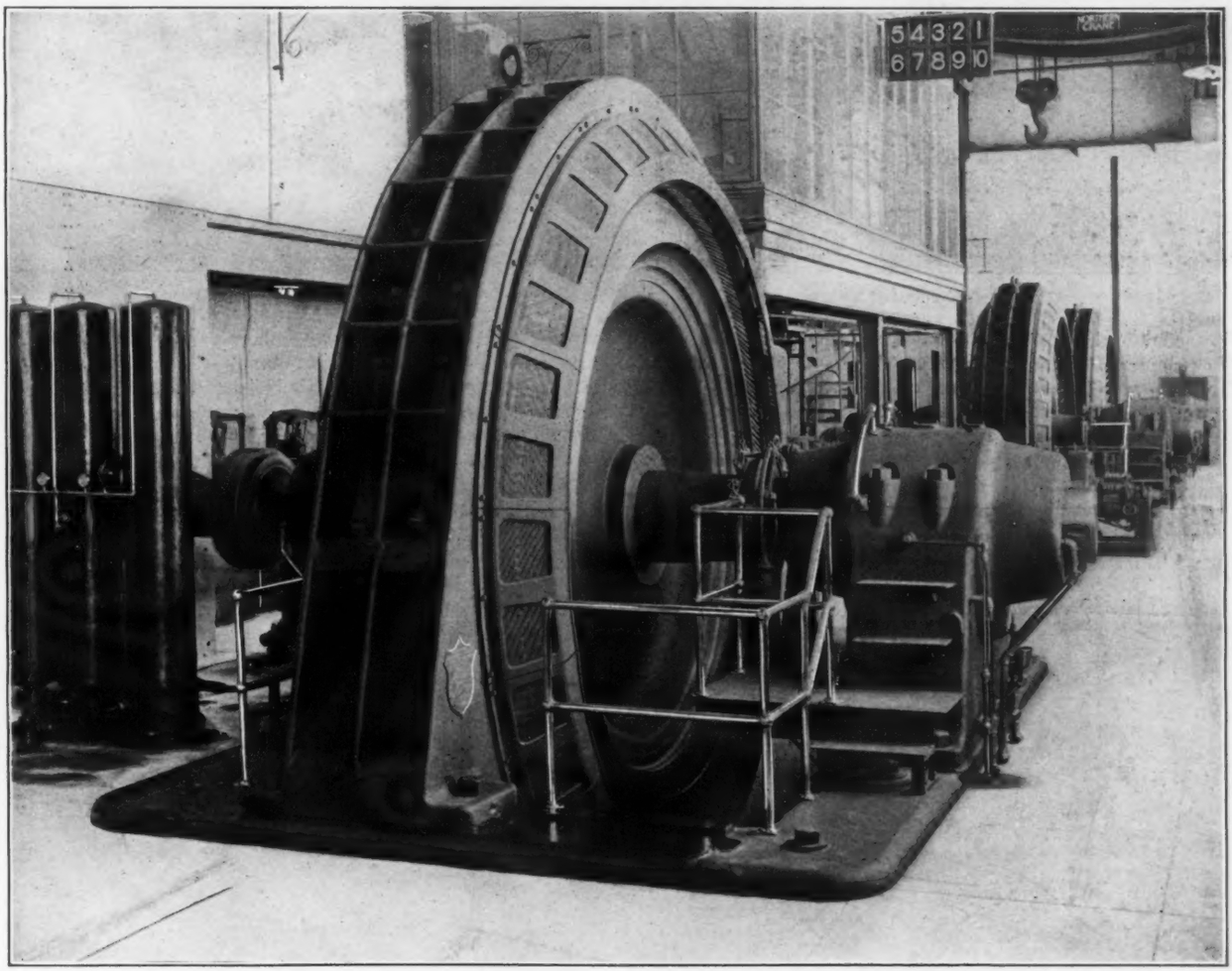


Fig. 5—Generating Station of Canadian Light & Power Company at St. Timothée.

In operating the station use is made of signal pedestals near each machine, a smaller panel for each unit being provided also at the benchboard in the gallery above. On one side of the pedestal are tablets bearing the following legends: "O. K.," "Full speed," "Start," "Stand by," "Shift load" and "Shut down," opposite each of which is a bull's-eye lamp. Extending from the switchboard gallery is a common signal set, flashing numbers one to ten and at the same time sounding an electric automobile horn. This set is controlled from the middle panel of the benchboard and indicates to the operator on the floor which unit he is to stand by. The bull's-eye lamps opposite the tablets are lighted from the switchboard gallery, indicating to the operator what action to take, and push-button switches are provided opposite each bull's eye so that the machine

The distance between the power station and the terminal station in Montreal is approximately 26 miles, and with the exception of crossings 52-ft. towers spaced 500 ft. apart are used to support the conductors. The towers carry a duplicate three-phase circuit of No. 2-0 stranded copper, a telephone circuit and an overhead ground wire. Locke pin-type porcelain insulators are used on the main circuits, which are designed to transmit 20,000 kw at a tension of 48,000 volts. In crossing the St. Lawrence special construction had to be employed owing to the fact that the river is a navigable stream. Where the line crosses, the river is 3400 ft. wide and about 30 ft. deep. Two steel towers, 130 ft. high, were erected on the banks of the river, and a steel tower 150 ft. high was built on two concrete piers extending 15 ft. above water and erected near the

center of the river about 700 ft. below the Canadian Pacific Railroad bridge.

Copper-clad steel cables 5/8 in. in diameter were employed for the main circuits, and 13/16-in. copper-clad cables were used for the telephone circuit. The length of spans is approximately 1750 ft. and 1735 ft. on either side of the river tower. The cables are made up of thirty-seven copper-clad wires and have a breaking strength of 20,000 lb. per square inch and a conductivity about 30 per cent that of copper cable of the same cross-section. The telephone circuit has higher tensile strength but the same ratio of conductivity as compared with copper.

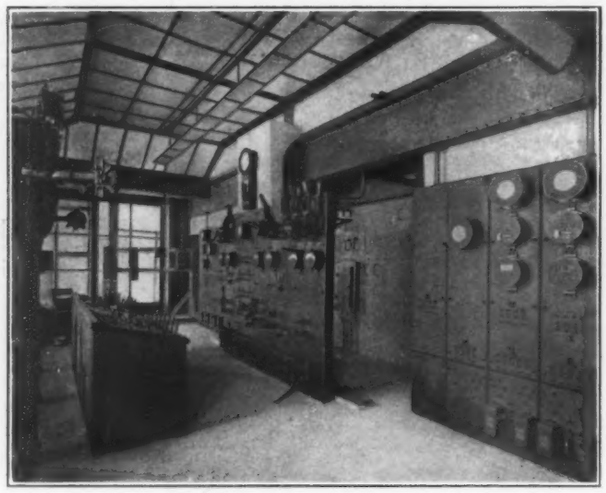


Fig. 6—Switchboard Room.

Special pains were taken to obtain a telephone system which would be reliable under the severe climatic conditions encountered and also under the conditions of operation. In the terminal telephone station the line enters through two 5-amp, 6600-volt fuses and cut-outs. The telephone equipment consists of a special telephone set having all metal parts arranged to be grounded, insulating transformer, extension bell, drainage coils, etc. Condensers are inserted in the telephone circuit to prevent the direct current from the telegraph equipment passing through the telephone apparatus. The condensers are provided with double-pole, double-throw knife switches so that if they are damaged they can readily be cut out and the line kept closed. Both condensers must be either cut in or cut out in order to keep the telephone line balanced and prevent noise. With the condensers cut out it is possible to telegraph using only one wire of the line, as explained later. A low-voltage protector is connected to the instrument side of the insulating transformer to discharge any static caused by disturbance on the line side. The knife switch connecting the telephone to the line must be left open when the set is not in use, so that the exciting current taken by the insulating transformer will not weaken the bell signals on the line. It is necessary that the extension bell and condensers be mounted on the same type of insulators as are used for the line to prevent their becoming grounded.

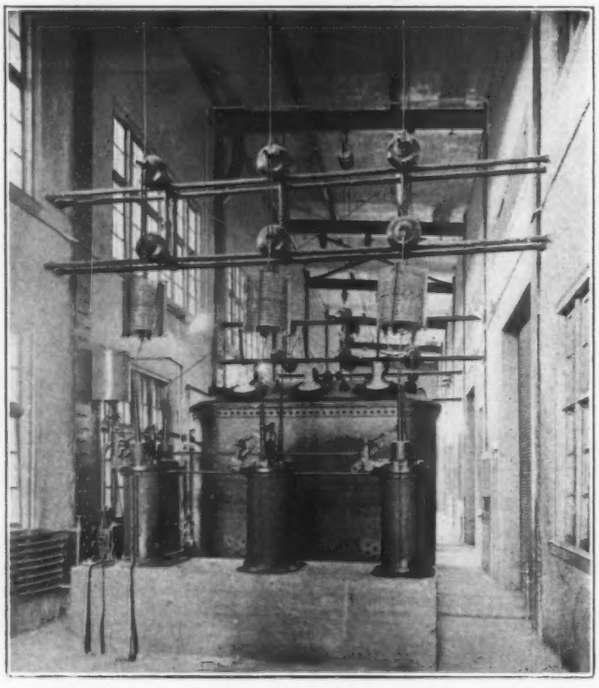


Fig. 7—High-Tension Transformers in Main Station.

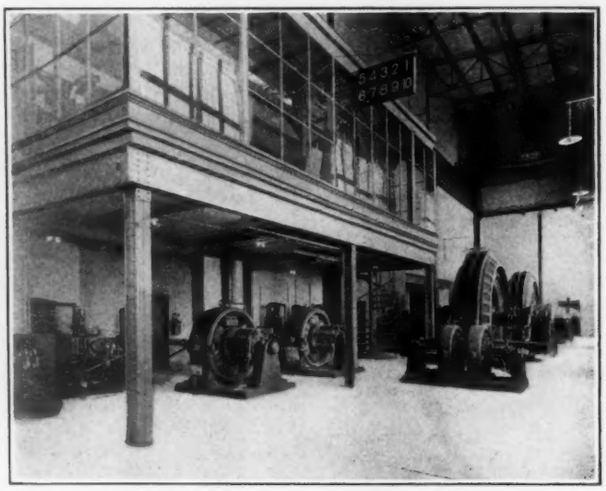


Fig. 8—Exciter Units and Booster.

The telegraph equipment consists of a retardation coil, line relay, key, line battery, sounder, local battery, etc.

Fig. 9—Tower at Canal Crossing.

The telegraph instruments are connected between the neutral of the retardation coil and the ground, so that the telegraph current will in normal operation divide and flow in equal amounts over each of the two line wires. Under these conditions there will be no interference with the telephone circuit. If one of the line wires is broken or grounded it can be cut out by means of switches provided and com-

munication carried on over the remaining wire. If condensers were not provided in the telephone circuit, a ground on one line wire would ground the other also through the bells, insulating transformers and drainage coils. A switch is provided in the neutral connection of the retardation coil so that if the relay is damaged it can be cut out without affecting the telegraph circuit between the other stations.

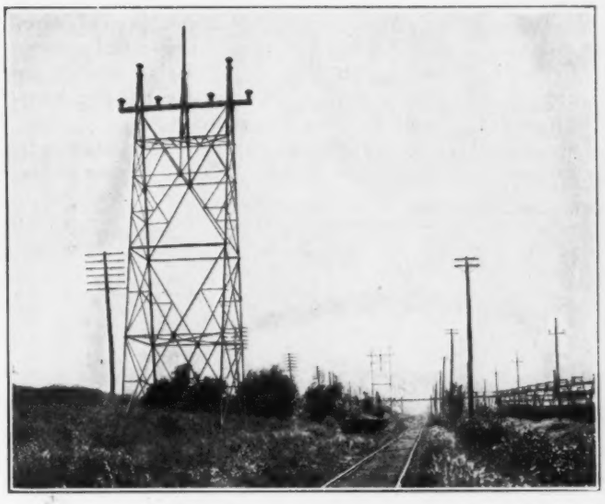


Fig. 10—View of Transmission Line.

All the wires for a station are installed on porcelain insulators and insulated for 6600 volts, except those portions connected directly with the ground. No twisted pair is used for wiring and none of the wire is installed in conduit. The knife switches are mounted on insulating supports, and the telegraph equipment is arranged so that the operator is insulated when using it. This precaution is taken because of the high voltages which may be present.

TERMINAL STATION.

The terminal station in Montreal is a fireproof structure, 50 ft. wide by 250 ft. long, housing the step-down transformer equipment and an auxiliary steam plant. The lines enter the station through oil switches and the high-tension buses are continued the length of the terminal station proper. Horn-gaps outside the station, operating in conjunction with electrolytic arrester on a gallery inside the

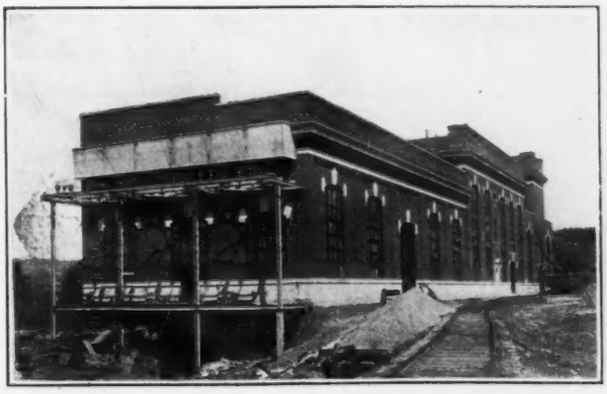


Fig. 11—Terminal Station at Montreal.

wall, protect the station equipment against surges and lightning troubles. Oil-insulated, water-cooled three-phase transformers of General Electric make, rated at 400 kva, step down the potential to 13,000 volts for local distribution, and at present four units are installed with space to spare for two more.

The switchboard equipment and switches follow standard General Electric practice. A feature of the switching arrangement is that a signal device is used on all high-tension switches to indicate the condition of the circuits by a bright or a dim light. This system is also applied to all bus-bar disconnecting and feeder switches, so that in addition to the ordinary red and green lights the operator has an independent lamp indication of disconnecting switches open or

Fig. 12—Step-Down Transformers and Circuit-Breakers.

closed. This device consists of an auxiliary switch connected by a stick from the disconnecting switch to the main switch. By this means disconnecting switches are not opened under load.

STEAM EQUIPMENT.

In the auxiliary steam station which occupies the other end of the terminal station there is at present installed a single 2300-volt, 1500-kw, three-phase, 60-cycle Allis-Chalmers turbine set, the energy from which is stepped up in a single three-phase transformer to 13,200 volts. Excitation for this set is supplied by a 75-kw Curtis turbine exciter set or a 75-kw motor-generator set or two 60-cell Gould batteries. Steam is generated in three 333-hp Babcock & Wilcox marine-type water-tube boilers fitted with chain-grate stokers for burning slack, or the furnace can be fed with fuel oil. The boilers are guaranteed to raise

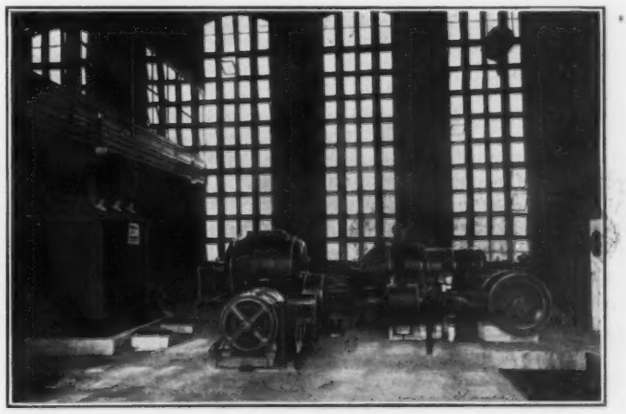


Fig. 13—Steam Turbo-Generator Set in Montreal Substation.

steam in twenty minutes. The coal is dumped from cars into a coal pocket below the track and conveyed thence by a Jeffrey conveyor to an overhead bunker holding 200 tons. From the bunker the coal passes through chutes to the hoppers of the stokers. The turbine is fitted with a counter-current jet condenser using canal or city water. Space is provided for another boiler and another 1500-kw turbine.

ERECTION OF TRANSMISSION LINES FOR THE UTAH LIGHT & RAILWAY COMPANY.

Details and Erection Cost Data of Double-Circuit Steel Towers—Handling of Material and Organization of Erecting Crews.

By L. J. Riter.

THE Utah Light & Railway Company has completed 42 miles of double-circuit steel-tower transmission lines, which bring energy into Salt Lake City from its plants north of the city. The trunk line, 38 miles in length, begins at the mouth of Ogden Canyon, where it receives energy from the Ogden Canyon and Bear River plants, and 10 miles south, on the west bluffs of the Uintah Valley, it connects with a steel tower line, bringing energy from the Devil's Gate plant in Weber Canyon. It then bears south and west to Layton, on the Oregon Short Line, and parallels that road through Kaysville, Farmington, Centerville and Wood's Cross into Salt Lake City, the company's main substation being on the Jordan River. Here are met incoming lines from the Cottonwood Canyon plants on the south, the Telluride transmission lines and those of the company's new steam-turbine plant.

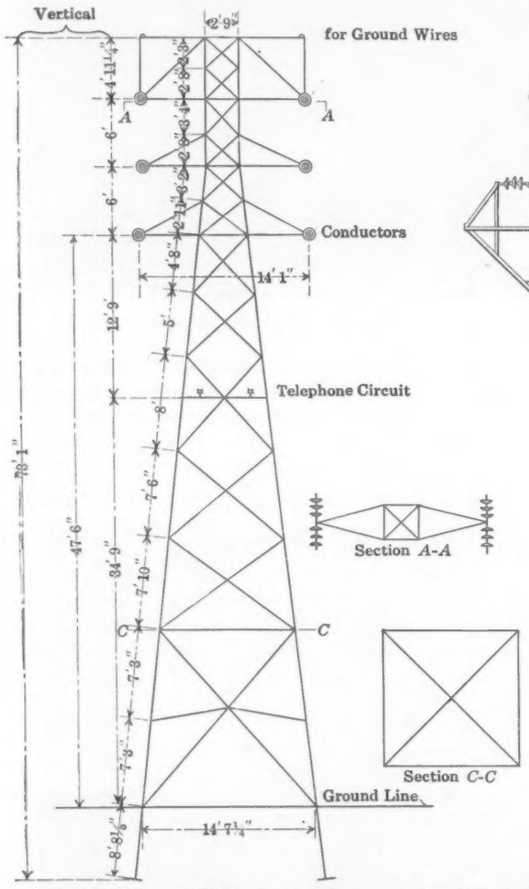


Fig. 1—Elevation of 65-ft. Anchor Tower on the Salt Lake-Ogden Line.

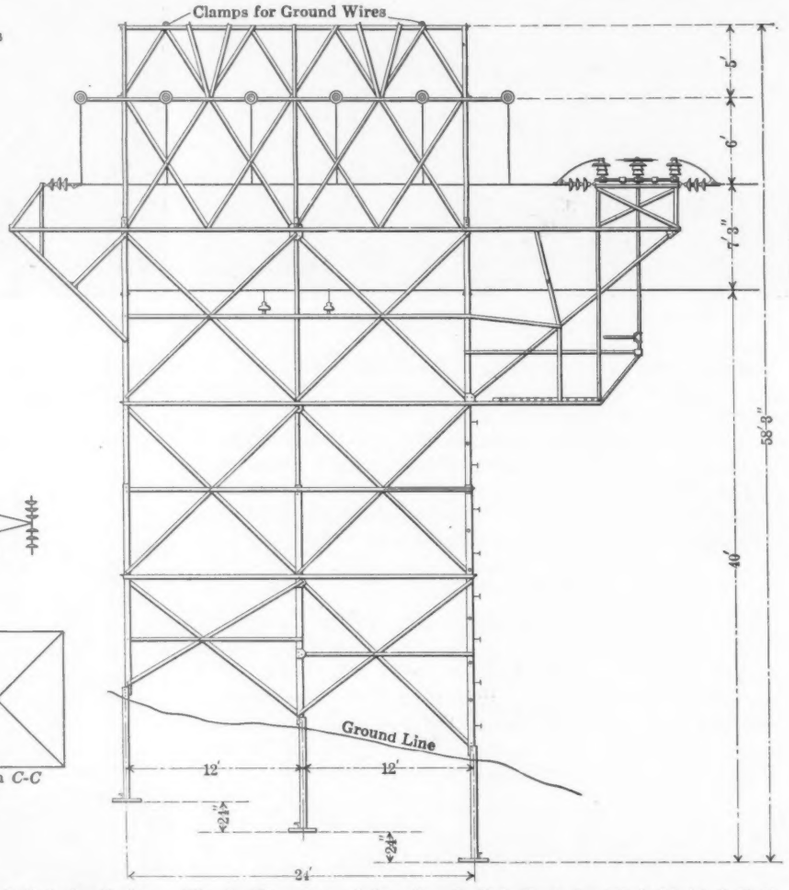


Fig. 2—Elevation of Junction Switch Rack for Utah Light & Railway Company.

RIGHTS-OF-WAY.

There is an average of ten towers to the mile, with spans ranging from 200 ft. to 1000 ft. in length. In purchasing the rights-of-way, deeds were obtained to a rod square of ground for each tower site, and to an aerial right-of-way for the spans, together with the permanent right to enter the land along the route for purposes of maintenance, the company to pay for all damages caused thereby to crops, fences or other property. For the greater distance the lines are built parallel to and near public highways from which they are patrolled. However, along 18 miles of the system just north of Salt Lake City, the line follows the Oregon Short Line Railroad 50 ft. outside of its right-of-way. Here the patrolling is done from the trains.

THE TOWERS.

The double-circuit towers carry in vertical planes on each side a three-phase circuit and an overhead ground wire, and a telephone circuit is run through the tower 12 ft. below the bottom conductor. (See Fig. 1.) These structures are from 65 ft. to 85 ft. in height, the lowest conductor arms being from 47 ft. to 67 ft. from the ground.

There are three standard types of towers, the line tower for suspension insulators on tangent line, the anchor tower for strain insulators on corners and dead ends, and the transposition tower on which the conductors change position. Specifications called for open-hearth steel, giving an ultimate tensile strength from 60,000 lb. to 68,000 lb. per square inch. Five-eighth-inch bolts were used, and the holes were punched 21-32 in. in diameter. All tower parts were galvanized by the hot process after shop work was completed, and the bolts and nuts were electro-galvanized after threading. No rivets were used.

One of the features of designing is the similarity of all towers and the interchangeability of their parts. For instance, all 65-ft. line, anchor and transposition towers have the same dimensions for the main members and bracing, only the weights of these being increased for anchor towers. For towers of greater height than 65 ft. the standard towers are used as superstructures, placed upon extensions properly proportioned for them, and made to meet the particular requirements of any location. A 20-ft. extension is used as standard for 80-ft. towers, and in no way

is the proper similarity of appearance between this structure and the more common 65-ft. structures affected. It will be appreciated that this arrangement greatly facilitates the work for future additions to the transmission system. The construction work is simplified, as a single template fits all standard tower bases, and the work of distributing material is not made complicated by a great variety of parts. The arms have a spread of 14 ft., and give a 6-ft. minimum clearance between conductors, and a 2.5-ft. minimum clearance from tower to conductors, for a swing of the insulators up to 30 deg. from vertical. Tests were made on one of each kind of tower, and they were found to meet the requirements necessary to withstand the following stresses: 2500 lb. at either ground-wire clamp and perpendicular to the vertical axis of the tower; 2500 lb. at any conductor support; 7500-lb. torsion applied at ends of three cross-arms on same side; 10,000 lb. for line towers, and 18,000 lb. for anchor towers on the main structure at the line of the center cross-arm, and 1000 lb. vertical downward load at both ends of any cross-arm.

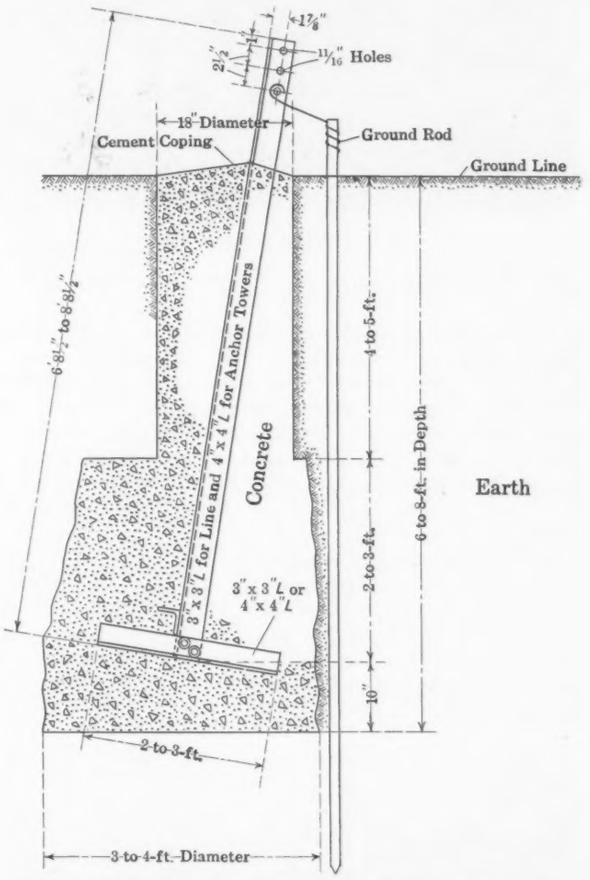


Fig. 3—Standard Footing and Anchor Post for Tower Base.

The towers run in weight from 4000 lb. to 6000 lb., and were shipped knocked down to the several railroad sidings near the route of the transmission lines.

SWITCH RACKS.

Line switches and junction racks are of steel and similar in design to the towers. Fig. 2 shows the type of rack used at the junction of the Devil's Gate and Salt Lake-Ogden lines. Use is made of double-break 66,000-volt, rotary-type switches mounted so as to break circuit on all three legs simultaneously. They are operated half way up the rack by a hand lever from an insulated platform, from which telephoning is also done. The rack holds the strain of the incoming lines, which are anchored to the switch-deck with strain insulators. The usual slack loop extends to the switches, the blades of which revolve horizontally, making or breaking contact at both ends of the blades. From the switches the wires are carried through the rack as buses on which jumpers are spliced so as to give the proper phase relations between the different circuits.

TOWER FOOTINGS.

All tower and rack footings are set in concrete. Fig. 3 shows the standard base used commonly in ground of ordinary bearing strength. In canyons or near river banks a stout riprap was used as additional protection. In sloughs containing water with corroding elements the cement copings were continued up the tower legs a foot or two, and in lakes or ponds reinforced-concrete piers were sunk through water and mud as deep as was necessary to reach solid bottom.

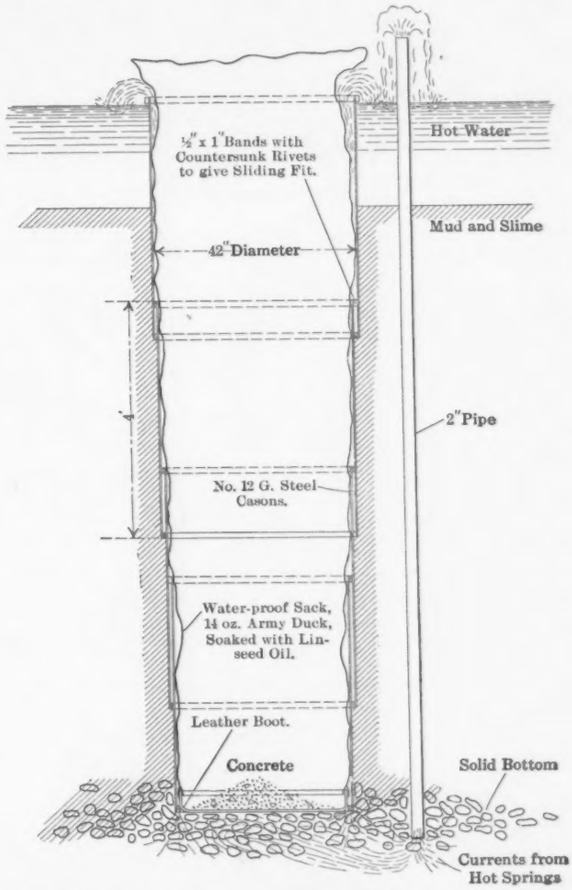


Fig. 4—Method of Placing Piers in the Hot Springs of Becks Lake.

INSULATORS.

The insulators are of the suspension type, and as the lines are at present operating at 28,000 volts, two disks are used for suspension insulators and three disks for strain insulators. In the near future an extra unit will be added throughout and the system will be changed to operate at 40,000 volts. A tensile test of 4000 lbs. was made on each unit, together with a close inspection of hardware, grouting and porcelain. The disks accepted on the mechanical inspection were tested electrically at arcing voltage, which was around 75,000 volts, the metal cap and pin forming the electrodes. The length of time that the test voltage was applied varied from 0.25 minute to 1 minute. Special tests revealed that a string of six units would show no sign of failure at 6000 lb. tension. Rain tests were made on three units. Connections were made as nearly as possible as in actual practice, and the units were subjected to a precipitation of 0.5 in. of water per five minutes at an angle of 45 deg. Under these conditions arcing occurred at about

145,000 volts, while the dry arcing emf for the three units was 225,000 volts. Fig. 5 shows the insulators and their hardware.

WIRES AND CABLES.

The ground wires are 5/16-in. Siemens-Martin steel-strand cable, galvanized, and the conductors are No. 0 B. & S. gage hard-drawn, seven-strand copper cable. The telephone circuit is of No. 4 B. W. G. extra steel pulling

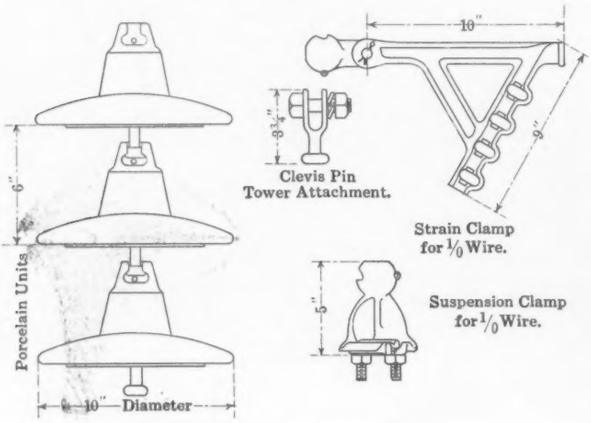


Fig. 5—Suspension Insulator and Parts.

wire, galvanized. A cable splice made 18 in. long without soldering was used on the ground wires and conductors, while a plain wrapped and soldered joint was used on the telephone wire. The position of the conductors was transposed one-third of a revolution every 3 miles, and the telephone circuit was transposed at every tower. Sag curves, computed to give an average maximum unit stress of 28,000 lb. per square inch with maximum conditions assumed as a 70-m.p.h. wind (actual) and 0.25-in. radial coating of ice, were plotted between sag, span and temperature. A sag of from 2 ft. to 40 ft. was indicated for spans from 200 ft. to 1000 ft. in length. The minimum clearance allowed was 28 ft. for conductors and 16 ft. for telephone wires from the ground. All towers are thoroughly grounded by means of a galvanized-iron rod driven 9 ft. into the earth with a

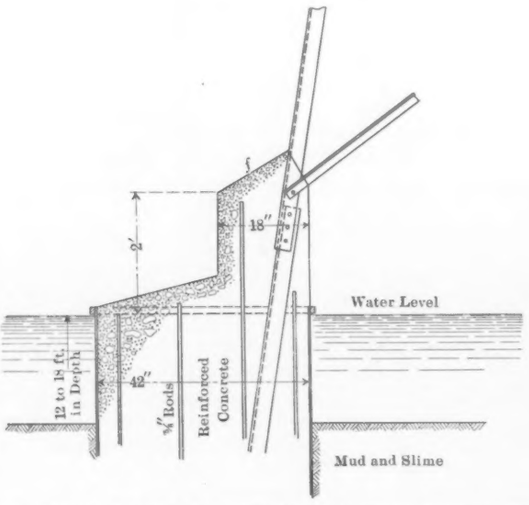


Fig. 6—Special Footing for Sloughs, Reinforced Concrete Piers.

soldered copper connection between the rod and one tower leg.

THE CONSTRUCTION WORK.

The time for completion of the lines was in this case an important factor, as the continuity of street railway and lighting service in Salt Lake was seriously imperiled by the effect of electrical storms on the old wood-pole line. The 38 miles of trunk line started in the spring of 1911 was completed and put in operation that fall. The cost, of course, was also a consideration. After the company had received from several reliable contractors bids all of which were higher than the estimates, it concluded to do the work on its force account. The result was a material saving over the lowest bid, a result which is not always experi-

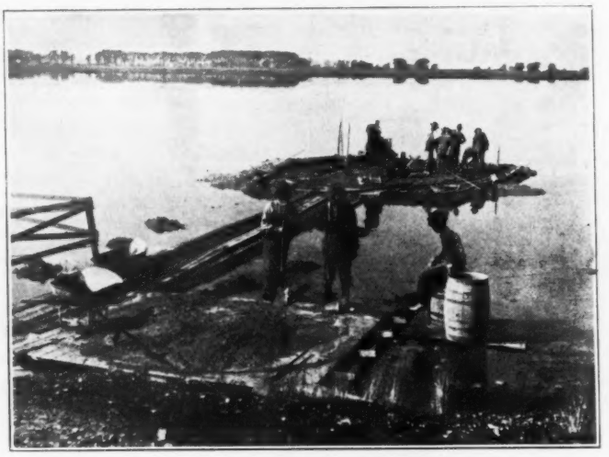


Fig. 7—Placing Concrete Piers.

enced by railway companies when they do work on force account.

The south half of the route taken is through the most densely populated part of the State, running near farm-houses and over rich truck gardens, making it difficult to deal with the people whose properties were crossed. The construction problems were increased here on account of having to leave occasional gaps, two or three spans in length, and return to them later, as well as on account of the large number of railroad, highway and electric line crossings.

All spans near buildings were made short and dead-ended on anchor towers placed on both sides of the buildings, the same plan being carried out for railroad, electric line and highway crossings. As explained before, this route was taken in order to parallel the railroad. The building problems on the upper end of the line were of a somewhat different nature, giving rise to long spans and

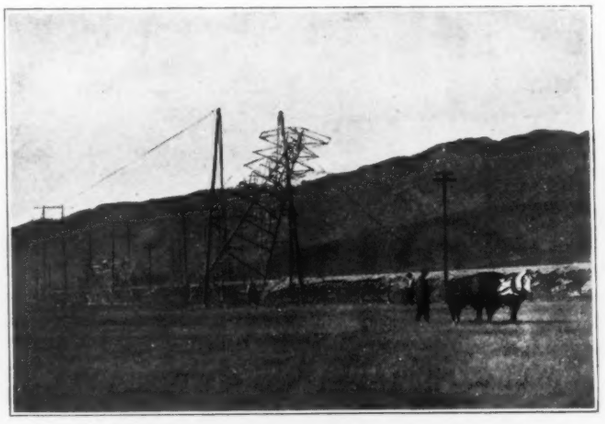


Fig. 8—Method of Erecting Tower.

steep ascent in the mountains. A 1000-ft. span with a change in elevation of 200 ft. is shown in Fig. 10.

Two construction camps were kept in operation, it being the aim to have the camps as near to the route as possible, and about 4 miles apart. The head camp housed the survey party, the material gang, including teams and outfits necessary for distribution, the excavation gang, the concrete

men and the assembling crew, as well as a timekeeper and a commissary clerk. The rear camp contained the erection crew, the line gang and an inspector. Each camp comprised a large dining tent and kitchen, a commissary tent, a tool tent, an office tent with telephone service, a stable and a number of bunk tents.

When moving the head camp was left for the men from the rear to fill, and the rear tents were jumped ahead 8 miles, the gangs coming into their new home at night and the work thus suffering little, if any, delay on account of moving. A transit party went ahead and laid out the line along the accepted route. The tower sites, previously located for the right-of-way agents, were now staked with a center hub at each location and four quarter stakes from which to line in the footings.

DISTRIBUTION OF MATERIAL.

The distribution of sand, gravel, cement, steel, insulators, hardware and wire was made complete for a location before work was started there. This distribution was handled with a work train for the lower end of the line, the material being thrown off in the railroad right-of-way opposite each tower site. Teams and wagons were employed on the upper end, as many as two or three teams being necessary in some locations to drag the steel to its place. Ordinarily one complete tower was the load for a wagon with one team, and the trip was made from the nearest railroad siding. The cost of distribution averaged $1.31 per ton.

EXCAVATION.

The excavation gang followed, digging out four footing holes for each tower. These holes, from 3 ft. to 4 ft. in diameter, were dug larger at the bottom than at the top and were 6 ft. deep for line towers and 8 ft. deep for anchor towers.

CONCRETE WORK.

The concrete was placed by a gang of twelve men with a team to haul water and transfer tools. The iron anchors were bolted to a template, which was lined up with the quarter stakes and leveled with a rod and level after 10 in. of concrete was placed under the cross-pieces of the anchor. The holes were then filled with concrete for another foot or two, when cylindrical steel forms, 18 in. in diameter, were used to carry the concrete on up to the top of the footing, earth being tamped for back-fill between the forms and outside of holes. When this was accomplished the

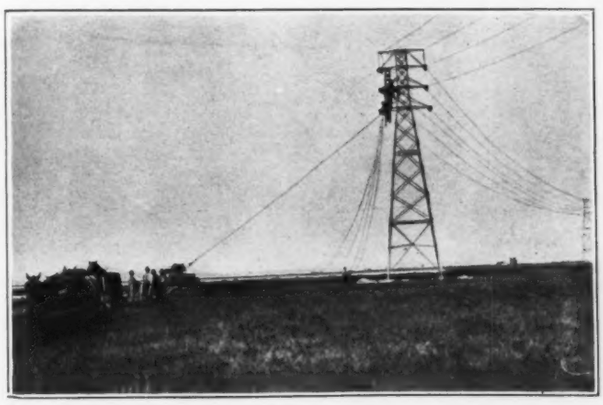


Fig. 9—Stringing Wire on Steel Tower Line.

forms were pulled out, and after the template was removed smooth cement copings finished the top of the bases. A ground rod was driven at one of the four corners. The average cost for labor on excavation was $2.25 per hole and for setting concrete $9.35 per tower, three to five sets being made in a day by one gang.

A mile of line was built through what is known as the Becks Hot Springs Lake and Sloughs. Here the special reinforced-concrete piers, as shown in Fig. 6, were used for footings. Steel caissons 3.5 ft. in diameter were sunk to a solid footing. The caissons were used in 4-ft. sections and made to telescope. The top sections were put in first and dredged out, then the second ones were dropped inside, and so on to as great a depth as was necessary. A truck

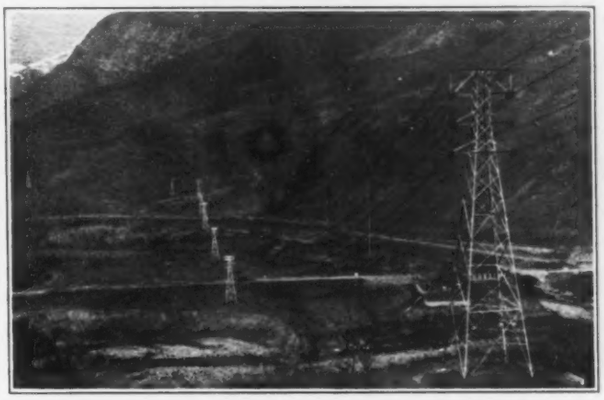


Fig. 10—A 1000-ft. Span.

fitted with a gasoline engine and centrifugal pump was used for the dredging. (See Fig. 7.)

In some locations the hot springs manifested themselves as flowing wells, which developed when the caissons were dredged out, so that by the time the forms were down to bed-rock a flow of 500 gal. per minute was obtained. To check this flow so that the concrete would not be washed up while setting, 2-in. pipes were driven down just outside the forms and bags were used inside to receive the concrete (see Fig. 4). This bag was made of canvas, waterproofed with linseed oil and armored on the bottom with a leather boot or cup of the same diameter as the lowest caisson. The bags were longer and larger in diameter than the forms, so that no tearing was done, and the bottom ends were sunk in place by filling their boots with ballast. This plan also gave opportunity to mix the concrete with fresh water, it being desirable to keep the hot water out of the mixture on account of the excess of sulphur and other impurities contained therein. As a bag became filled, it would be expanded tight against the forms, so that in a short time the water was forced back and up through the standpipe as indicated in Fig. 4.

ASSEMBLING AND ERECTING.

The towers were assembled on the ground and all insulators bolted in place by the assembling crew. This crew, consisting of eight men, carried sets of step-ladders, running boards and solid wrenches. The erection outfit, containing eight men and two teams, followed. They used two 45-ft. gin poles, both of which were equipped with a set of block and tackle and three guy lines, oak and iron stakes being driven for the guys. A team was used on the fall line of both gins.

The writer made a series of trials on the erection work of another line, several methods being employed. The "A" frame and tipple board possessed advantage for simplicity of equipment, while a single gin pole replacing the "A" frame threw less strain on the lines and structure during the first pull.

The disadvantage here encountered was that the location would not always permit the proper placing of the tower in order to tip it up. Use was then made of a single gin which would lift the tower bodily and set it on end. This plan was also successful but required more or less swinging of the structure in mid-air. It was concluded, however, to adopt this method by using two gins of lighter weight placed on either side of the base, which plan proved very satis-

factory, as the assembling crew could build the structure in the most convenient position for them and the tower could always be snaked and swung easily into place. The equipment was complete for any location and no further preparations or special tools were required for especially inconvenient erecting. At first one team took both lines, but two teams were used later to facilitate the work. Six towers per day were erected by this crew at a cost of from $4 to $9.50 per tower, depending upon the location. The assembling cost was $10 per tower, including attachment of insulators. Thus the total average cost throughout the entire installation was $18.50 per tower, or $8 per ton, for assembling and erecting.

WIRE STRINGING.

The line gang contained five linemen, six groundmen and two teamsters and teams. A reel carriage, made up of three carts linked together, each carrying a reel of 1 mile of wire, was dragged along the route, and the wires were hung in snatch-blocks on the arms of the towers. In this way a complete circuit was payed out on each trip (see Fig. 9).

The wire was pulled up every half mile and transferred from the blocks to the insulators. The ground wires were sighted in first from the towers, the conductors being sighted from the ground so as to conform in sag with the ground wires. Lastly the telephone circuit was taken through and transpositions cut in it at every tower. The ground rod connections were then bolted and soldered in place.

The wire was strung complete for a cost of $175 per mile. All of the gangs were kept supplied with the best tools, as the most efficient aid to economy. A final inspection was made over the whole route by a small gang of linemen, who cleared the circuits of grounds, phased them out at junction points and cut in the lines for operation, taking pains to remedy any other trifling defects in construction which they encountered.

It may be of interest to know that no guys whatever are in use for the purpose of holding structures on corners, dead ends or elsewhere, and that the Devil's Gate line, which has been in operation for one year, has not suffered any interruption to service.

The lines were built under the supervision of Messrs. O. A. Honnold, electrical engineer, and W. M. Scott, superintendent of lines for the Utah Light & Railway Company, the writer, as construction engineer, being in direct charge of the erection work.

ELECTRIC FARMING NEAR DAYTON, OHIO.

Central-Station Service Employed for Motor-Operated Machines on a Typical Country Estate.

SIX miles from Dayton, Ohio, Mr. William Stroop has a large estate where good use has been made of electricity supplied over a three-phase, 6600-volt transmission line from the Dayton company. A 15-hp motor

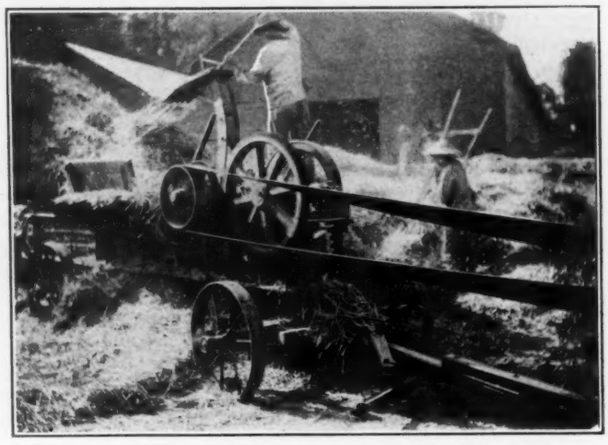


Fig. 1—Baling Straw by Electric Motor.

mounted, with its starter, on a portable truck can be moved about the place to drive a corn husker, shredder, wood saw and thresher. Another 3-hp motor drives a deep-well pump, delivering the water supply for the estate to a reservoir on the hilltop. A ½-hp motor pumps cistern water, and the laundry is equipped with a motor-driven mangle. This year it is planned to install electric irrigation on a large scale to intensify the output of the soil, and later experiments will be carried out with electrification to stimulate plant growth.

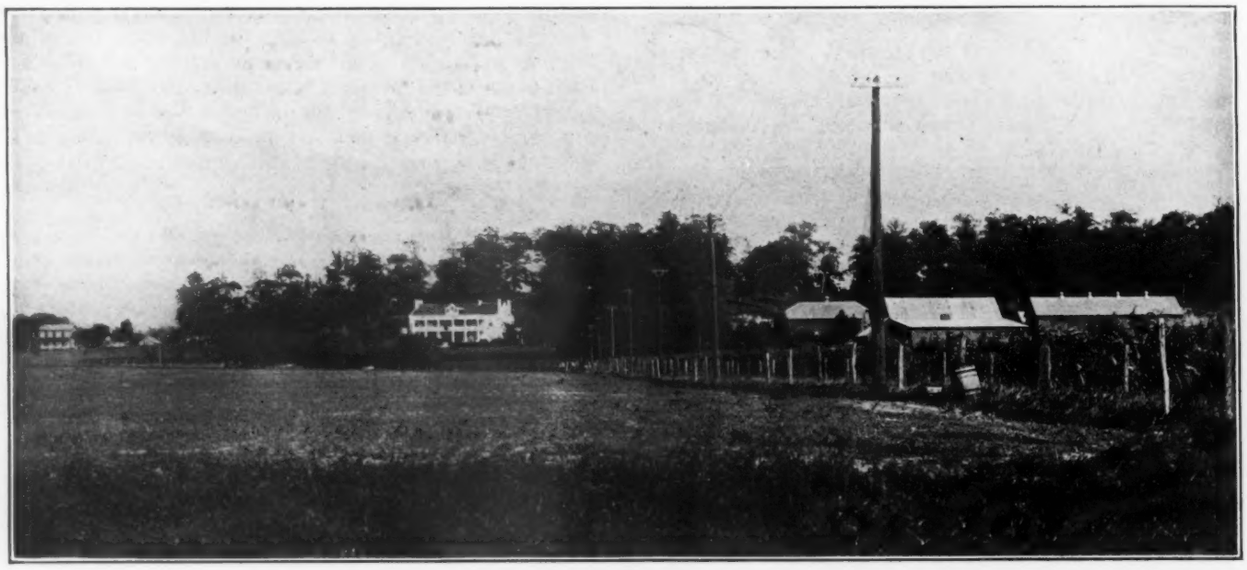


Fig. 2—Three-Phase Transmission Line to Stroop Farm.

Tests were recently made at the Stroop farm to determine the power required and energy input for various farm operations. For example, it was shown that 1750 bushels of barley could be threshed at an expenditure of 220 kw-hr., the maximum demand being 20.5 kw. In this Montgomery County section steam-thresher hire costs $20 a day.

In a series of ten-minute tests to learn the power required

by a corn grinder running idle, it was found that the motor alone consumed 0.106 kw-hr., and the motor and grinder 0.341 kw-hr., leaving 0.235 kw-hr. chargeable to the idle grinder, or an average demand of 1.41 kw. Three tests were then made of the energy consumed in the operation of grinding corn, with the results tabulated.

Fig. 3—Motor-Driven Threshing Machine.

In the third test the corn was husked directly from the shocks and was still damp, so that excessive power was

ENERGY USED IN GRINDING CORN

	Bushels Ground.	Time, Minutes.	Bushels per Hour	Total Kw-hrs.	Kw-hrs per Bushel	Bushels per Kw-hr	Maximum Kw.	Minimum Kw.	Average, Kw. Dev
Test No. 1	23.57	35	40.4	9.67	0.408	2.45	20.7	10.9	16.5
Test No. 2	22.60	33	41.1	9.36	0.414	2.41	21.0	1.10	17.0
Average	.....	....	40.7	....	0.411	2.43	....	....	16.7
Test No. 3	12.00	21	34.2	7.29	0.607	1.65	25.8	14.4	20.8

required, as shown. For this reason the last line of results are not averaged with the others as representative.

The same motor was also tested driving the shredder and

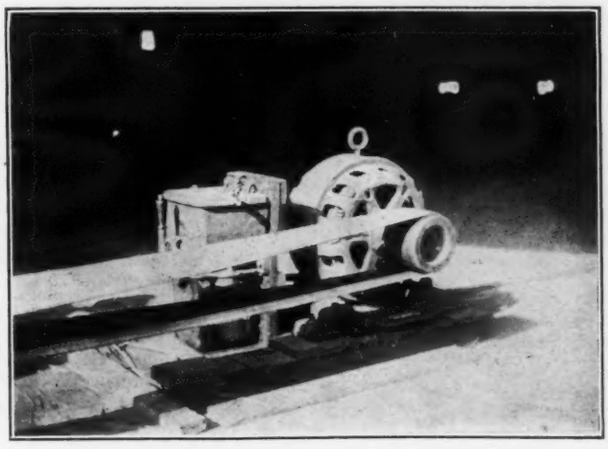


Fig. 4—15-hp Motor on Skids.

husking machine, which running idle consumed 1.425 kw-hr. in ten minutes, or 1.319 kw-hr. for the machine alone, indicating an average input of about 8 kw. Fifteen hundred pounds of fodder was shredded in twenty-three minutes, consuming 4.03 kw-hr. This shows an energy consumption at the rate of 5.37 kw-hr. per ton, or 0.186 tons shredded per hw-hr. The maximum kw taken was 14.5 and the minimum 8.2, indicating an average of 10.5 kw. Nearly 40 tons of fodder are shredded yearly at the Stroop farm, the average cost of shredding which would be $3 a ton were the present electric appliances not used. The Dayton company built the pole line and furnished the transformers and meter for the Stroop installation, all other equipment being the property of the customer.

ELECTRIC PROPULSION OF THE U. S. COLLIER JUPITER.

Induction Motors Fed with Energy from Steam-Driven Turbo-Alternator Drive Propellers.

THE first instance of electric ship propulsion on a large scale, as exemplified by the equipment for the new government collier *Jupiter*, was noted in our June 1 issue, where brief notes were presented regarding the general features of this installation, including certain comparisons with the steam-driven sister ships *Cyclops* and *Neptune*. Further details of the equipment are now available and are presented in what follows.

The generating unit for the *Jupiter* consists of a six-stage Curtis turbine connected to a bipolar alternator, the speed of this unit at 14 knots being about 2000 r.p.m. and

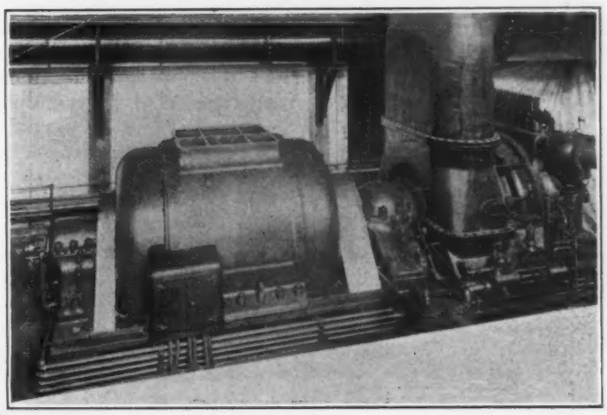


Fig. 1—Turbo-Generator on U. S. Collier Jupiter.

the voltage about 2200. This generating unit delivers its output to two motors, one mounted directly upon each propeller shaft. These motors have thirty-six poles, and therefore the ratio of synchronous speed reduction is 18 to 1, the propellers at 14 knots being designed to operate at 110 r.p.m. In addition to this apparatus there is a switchboard equipment which embraces oil switches for connecting the motors for either direction of rotation, and instruments which show and record the electric power delivered to the motors. There are also two water-cooled resistance devices, which are placed in circuit with the revolving elements of the motors during the process of reversing. Connections for the insertion of these resistances are made by sliders on the motor shafts, operated by levers attached to the motor frames. The generating unit and motors are self-lubricating and self-ventilating. Sheet-metal ducts will be connected to their air outlets in such a manner that the heated air will be led to the suction of the fire-room blowers, so that it will not be released in the engine room.

Since in such an equipment it is only necessary to generate enough energy for the actual driving of the ship, it is possible so to design the equipment that the maximum power which can be delivered by the generator is not greatly in excess of the normal requirements, and this fact practically overcomes the possibility of destructive trouble through

wrong connections. It has, however, been thought desirable to arrange interlocks in such a manner that wrong connections cannot be made, the conditions being such that these interlocks involve no complication or uncertainty. Provision is thus made by which the go-ahead switch and the reversing switch cannot be closed at the same time and by which neither switch can be closed unless the resistance is

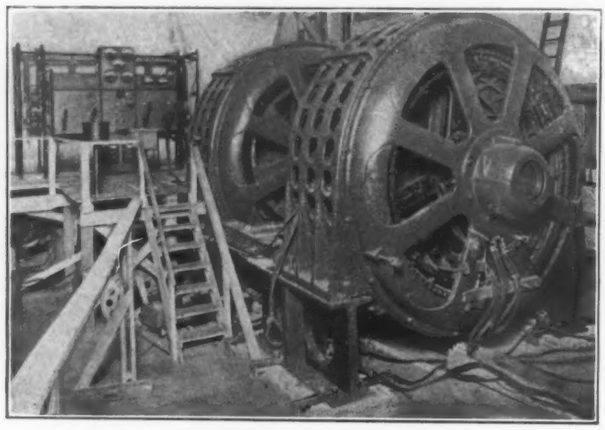


Fig. 2—Induction Motor for U. S. Collier Jupiter on Test Bed.

in circuit with the motor secondary. For the levers which throw the resistances in and out of circuit magnetic locks are provided which in turn are energized from the field circuit of the generator. These locks prevent the movement of the levers until the generator has lost its field magnetism, and thus prevent any possibility of burning of contacts through movements at the wrong time or in the improper manner.

The speed of the motors in this vessel will be changed by variations in the speed of the generating unit, the ratio of speed reduction remaining fixed. The changes of speed, however, are not made by throttling, as is usual with ship turbines. The turbine is equipped with a governor of novel construction, which is so arranged that it is capable of automatically holding the speed at any point from about 5 knots up to the maximum. The setting of this governor is accomplished by the movement of a fulcrum which is controlled from a point near the switchboard and operating levers. Thus the operating engineer, without changing his position, can run the vessel at any desired speed ahead or astern, can stop and start, and from his instruments can see the speed and amount of power delivered to each propeller. When the apparatus is installed in the ship arrangements will also be made by which in the same position he can open and close the main throttle valve by hand or trip it so that it closes instantly. The generating unit is also equipped with a simple automatic device entirely separate from the governor which trips the main throttle in case the speed of turbine exceeds a certain predetermined limit.

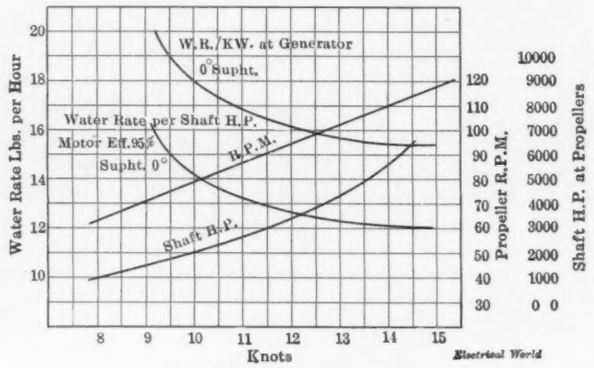


Fig. 4—Test Curves of Generating Unit.

The propulsion methods used on this ship constitute the simplest known form of electric power transmission. Apparatus of similar character is used for a great variety of purposes on shore under conditions far more complicated and difficult, and yet with an immunity from trouble which is practically complete. No insulation difficulties, with the voltages here used, are anticipated. The equipment itself is particularly rugged and represents no departures from long-established practice. The switching apparatus is of an entirely reliable standard type, can be easily replaced or repaired, and if it were all removed the ship could easily be operated with temporary connections.

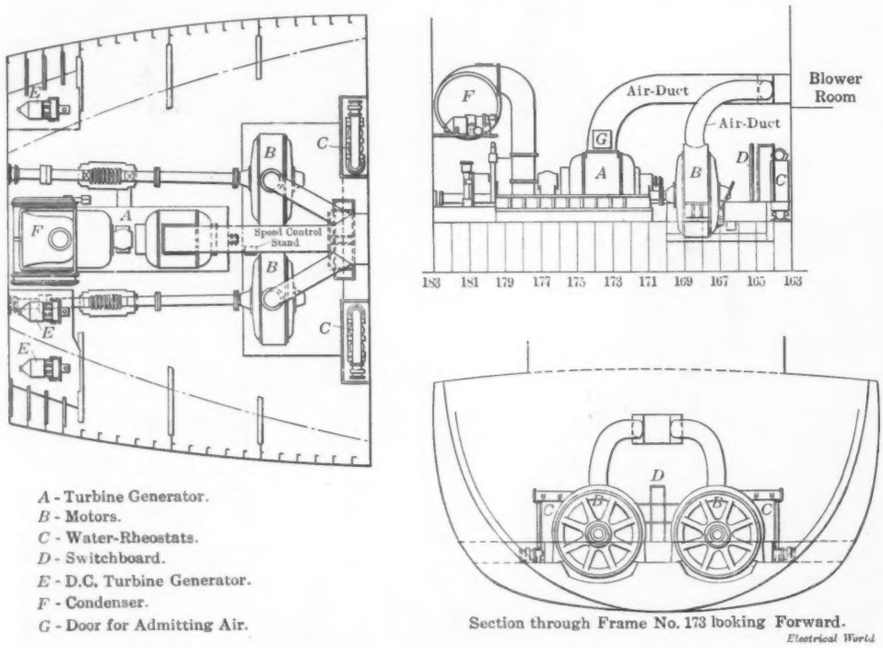


Fig. 3—General Arrangement of Equipment on U. S. Collier Jupiter.

The turbine is so designed that all of its parts are accessible and replaceable, and extra parts will be carried on the vessel, so that it seems impossible that the machine will be subject to any serious interruption of service. While it is normally controlled by the governor as described, it is in no way dependent upon the governor, since by a simple disconnection it can be operated by the throttle from a point near the switchboard and motor levers. The turbine has six separate stages, and in the event of loss of blades in one or more of these stages it could quickly be arranged to operate on the remaining stages without any renewals. Any one stage of the turbine would propel the ship above half speed.

The whole apparatus was recently set up in the manufacturer's shops for a test, the turbine being connected to a condenser and one motor being installed in the same position which it will occupy on board ship with relation to the switchboard and controlling mechanism. The other motor was arranged as a generator and coupled to the

first motor so that it afforded a load. Using this generating motor as a load, the conditions of service were approximated, although they were actually more difficult than the driving of a propeller, since the load falls off only slightly with diminutions of speed unless the exciting current is reduced. With the apparatus so installed, the processes of starting, stopping, changing speed and reversal can be accomplished very much as they would be on board ship and the time and difficulty involved can be correctly judged. The motor can be operated at its full load or any desired proportion of this load and at any desired speed, the control being accomplished by mechanical connection to the governing mechanism of the turbine, substantially the same as on shipboard.

This arrangement afforded means of experimenting with the operation, but did not afford means of testing the water rates, since only one motor could be loaded. The water rates of the generating unit have been tested under all loads and conditions by delivering its power to a water rheostat in the usual manner, and the record of these tests is shown by the accompanying curve sheet, in Fig. 4. In these tests the effects of speed, voltage, vacuum and superheat were all thoroughly investigated and a series of tests was run under almost exactly the conditions of load, speed and voltage which will be characteristic of the ship's operation. The tests were made under almost the precise conditions of steam pressure and vacuum specified for the ship.

In the interval since the turbine for this vessel was designed new developments have been made which indicate that certain changes of design would accomplish a material improvement in the water rates shown by the tests above mentioned. Inasmuch as it is desired to make this installation representative of the best practice, it is proposed to rebuild the turbine if the government will allow the necessary time. The new data indicate that by such rebuilding the water rate at 14 knots will be reduced from 12 lb. per shaft hp-hr. to about 11.25 lb. per shaft hp-hr. The entire equipment is being furnished by the General Electric Company.

CHANGING THE SIZE OF WIRE ON SHUNT COILS.

By Alan M. Bennett.

Shunt coils enter into the design of electric apparatus of a wide variety of types. These coils are generally designed to produce a certain magnetizing force or number of ampere-turns at a maximum allowable temperature rise, and may be assumed to be a standard for the particular piece of apparatus for which they are designed. In many cases, however, where such coils are employed it frequently becomes necessary in adapting this apparatus to special conditions to change the size of wire with which they are wound.

Among the results to be obtained from such changes may be mentioned slower speeds in motors, by the use of larger wire on the field coils, it being possible in many cases to obtain speeds in this manner which otherwise would necessitate special armature design. By a similar change one can often obtain a field strength that will permit of speed variation by field weakening. The use of a wire of smaller size will result in decreased current and heating in the coil, a condition often necessary in meeting efficiency and temperature specifications. The result of increasing the size of wire in the field coils of generators is a higher voltage at the machine terminals. In the case of solenoids the use of a larger wire will increase the magnetizing force and the pull on the plunger.

Examples may be multiplied, and of course in any of these cases the results are possible only within certain limits. Conditions will arise, such as the degree of saturation of the magnetic circuit, which will limit the result if carried too far.

In all cases, however, where such changes are made questions will arise as to the effect produced on the ampere-turns of the winding, the watts generated and the consequent temperature rise, and the alterations to be made in the coil to keep the heating within allowable limits. That the effect produced in all these cases follows some definite rule must be evident, because of the fixed relation between the various sizes of wires.

Wire of B. & S. gage only will be considered below, inasmuch as this gage is employed almost universally in this country. The cross-sectional areas of consecutive sizes of this wire have the ratio of 1 to 1.25. As the thickness of insulation on single-covered wire of the sizes most commonly used on shunt windings, namely, up to number 27, is a small percentage of the wire diameter, the sectional areas of covered wires will have approximately this same ratio of 1 to 1.25, and it is on this ratio that the following rules are based.

Let a equal length of winding space; b equal depth of winding space; d and D equal the covered diameter of any two sizes of wire. Then, considering the turns to be wound in regular order, the number of turns of each size that can be wound in this space will be, respectively, $\frac{a \times b}{d^2}$ and $\frac{a \times b}{D^2}$. The ratio of the turns in the two cases will be $\frac{a \times b}{d^2} \div \frac{a \times b}{D^2} = \frac{D^2}{d^2}$; that is, with a given winding space the number of turns of any two sizes of wire that can be wound in this space will be inversely proportional to the squares of the diameters. Now, the squares of the diameters of two wires have the same ratio as their cross-sectional areas, which we have seen is 1 to 1.25. Therefore, the number of turns of any two consecutive sizes of wire than can be wound in a given space will be in the ratio of 1 to 1.25.

The total resistance of the coil depends on the number of turns, the resistance per unit of length of the wire and the length of mean turn in the same unit in which the resistance is expressed. With a given winding space the length of mean turn will be constant and the resistance will depend on the former two only. Now we have seen that in a given winding space 25 per cent more turns of any given wire can be wound than of the preceding size, and it is a property of wires of B. & S. gage that each size has a resistance per unit of length 25 per cent greater than the preceding size.

Therefore the resistance of two coils of like dimensions, wound with consecutive sizes of wire, will be in the ratio of 1 to $(1.25)^2$ or 1 to 1.56.

The next effect to be considered is the relation of the ampere-turns resulting when the two coils are subjected to the same voltage. As their resistance is in the ratio of 1 to 1.56, the current which will flow through them due to this resistance will vary inversely as this resistance, or as 1.56 to 1. That is, the coil of larger wire will pass 56 per cent more current than one wound with the smaller wire. But the former coil contains only 80 per cent of the number of turns that the latter does. The ampere-turns then in the case of the former will be $1.56 \times 0.80 = 1.25$ times that of the latter.

Therefore, when two coils of like dimensions, wound with consecutive sizes of wire, are subjected to the same voltage the resulting ampere-turns will be in the ratio of 1 to 1.25.

The watts generated in a coil vary as the product of the amperes passing through the coil and the voltage at its terminals. As this latter is constant for the coils in question, their respective watts will vary directly as the amperes flowing through them. This we have found previously to be in the ratio of 1 to 1.56.

Therefore, when two coils of like dimensions, wound

with consecutive sizes of wire, are subjected to the same voltage the resulting watts loss will be in the ratio of 1 to 1.56.

Inasmuch as the radiating surface of the coils in the two cases is the same, the watts per square inch radiated from this surface will also be in the ratio of 1 to 1.56. At a given number of degrees rise per watt per square inch under like conditions the two coils will then rise in temperature in this same ratio. This variation in heating in many cases will not be permissible, and a question arises as to the percentage of increase or decrease in turns that must be made to keep the watts per square inch at or near their original value when a change is made in the size of wire. Consider the case where the change is made to the next larger size. Here the watts will increase by 56 per cent, and turns will have to be added to the coil in sufficient number for the decreased current and increased radiating surface to balance this amount.

If the coil can be lengthened, leaving its diameter the same, it is evident that by adding 25 per cent to its length the desired result is obtained, for this means 25 per cent more turns and resistance, thereby reducing the current to 80 per cent of its former value. The radiating surface is likewise increased 25 per cent, and the net result is that the watts per square inch are the same as on the coil with the smaller wire. It will be noted that in this case the ampere-turns remain the same as before the coil was lengthened, inasmuch as the number of turns has been increased to 125 per cent and the current reduced to 80 per cent of its former value.

If, however, the coil cannot be increased in length but the addition of turns has to be made to the outside, then the percentage of increase in turns will have to be determined for each particular case; it is not possible to lay down any simple rule for the number of turns to be added, as a certain percentage of increase in turns will not in all cases increase the resistance by any fixed percentage, the increase in resistance depending on the increase in length of mean turn, and this depending on the ratio of depth of winding to inside diameter of coil. Unlike the preceding case, it will be found that where turns are added to the outside of the coil the ampere-turns are lessened. This is attributable to the fact that the length of mean turn is increased, which effects an increase in resistance in addition to that caused by the increase in turns. The current therefore decreases at a greater rate than the turns increase, with the result that the ampere-turns are lessened. This decrease in ampere-turns will be greater in those cases where the depth of winding approaches more nearly in dimension to the inside diameter of the coil. For example, a coil with an inside diameter of 2 in. and a depth of winding of 1 in. will have its ampere-turns decreased 8 per cent by the addition to the outside of the coil of 25 per cent more turns.

When the change is made to a wire of the next smaller size the opposite of the foregoing is true. Here the watts will decrease to approximately 65 per cent of their former value, and turns can be taken off the coil in sufficient number to bring the watts per square inch radiated back to what they were before the change was made.

If the coil can be shortened, it will be found that a reduction in length of 20 per cent will give the desired result. If turns have to be taken off the outside, then for reasons previously stated the turns for each case will have to be determined separately.

The foregoing has dealt with a change to a wire of the next larger or smaller size, but results from a change to two or more sizes can be readily deduced from what has been given. For example, the number of turns of any given wire and of one two sizes smaller that can be wound in the same space will have the ratio of 1 to $(1.25)^2$; the corresponding watts will be in the ratio of $(1.56)^2$ to 1, and so on.

TWO YEARS OF PRODUCER EXPERIENCE AT AMARILLO, TEX.

After two years of bituminous producer-plant operation with varying results, the Amarillo Water, Power & Light Company, of Amarillo, Tex., is now obtaining quite dependable and satisfactory service from its producer equipment, developing a kilowatt-hour on 2.25 lb. of the New Mexico coal used, which has a fuel value of 11,300 heat units per lb. Besides its auxiliary steam-driven apparatus, the Amarillo central station includes two 220-kw Westinghouse bituminous producers and two 180 kw Westinghouse horizontal gas-engine sets generating 2300-volt, 25-cycle, three-phase energy.

When first installed the producers gave trouble from excess tar which entered the engine cylinders, fouling them and resulting in sticky valves and other troubles. This tendency to make tar was caused by "hot spots" in the fuel bed, so that every possible precaution is now taken to insure uniform temperature throughout the combustion zone. Every hour or two the man on watch inspects the fire through portholes just above the vaporizer gallery. Unequal temperatures are quickly spotted by the color of the fire, and any inequality is quickly corrected by drawing out ashes. The producers are charged hourly, twenty-five to thirty scoop-shovelfuls being added at each charge. Ashes are removed once in each eight-hour shift, one wheel-barrowful being taken from each quadrant of the submerged ash pit. Twelve wheel-barrow loads per day are drawn in this way from the four pits, corresponding closely with the theoretical ash contents of the coal fired.

When a high spot is detected in any part of the fuel bed by the hourly inspections above noted, several wheel-barrow loads of ashes are at once drawn from a point directly beneath, regardless of the regular time for removing ashes. With the aid of a bar other partially coked fuel is then raked in from the top of the bed and the surface is made uniform. A cold spot is similarly corrected by drawing out ashes and allowing fresh fuel to drop into its place. While the presence of cold spots is without damage to the producer operation, except to decrease its output, the high spots may cause serious trouble by liberating tar which fouls the engine valves and parts. A skilled attendant can readily compare the temperature at different points by feeling the radiation from the shell of the producer.

Trouble has also been experienced from the cracking of vaporizer castings. To prevent this difficulty apparently requires a degree of attention to the water supply for the producers about as close as for a steam boiler. Once each day a quantity of boiler compound is added to the water in the vaporizers, and once each shift, or three times daily, the vaporizer is blown off to insure the absence of scale and free circulation of water in all parts. To the presence of scale and lowering of water level are attributed the difficulties first experienced from the cracking of castings.

The Amarillo producers are kept in continuous service thirty days at a time, and in certain instances have run two to three months without their fires being drawn. These producers are of the type commonly rated by their manufacturer at 220 kw, but on account of the high altitude of Amarillo, 3600 ft. above sea level, their capacity is correspondingly reduced to 180 kw, for which the engines are installed. The coal used at this plant evidently contains sulphur in pyrites or other form. An acid is apparently formed and delivered to the engines along with the gas, causing the rapid eating away of the engine piston shafts, exhaust valves, etc., for which no remedy has thus far been found. The producer units have been operated in parallel without difficulty on several occasions, and the engine units are easily synchronized. During a sixty-day test recently completed on one of the Amarillo outfits, 2.25 lb. of coal was consumed for each kilowatt-hour generated.

GAS-PRODUCER PLANT AT WINDHAM, OHIO.

By F. A. EBERWINE.

The appearance of gas producers and reliable gas engines on the market has made possible the use of electricity in towns which are removed from water-power or from large distributing systems. The gas-producer plant at Windham, Ohio, furnishes an excellent example of how electricity can be supplied to a small town at a comparatively low cost. This town has a total of only eighty-five dwellings and business places and a population of only 265, yet at the present time it boasts of forty street lamps, and although the plant has been in operation but one year, forty-eight of the eighty-five buildings are wired and the occupants use electric light. The owners of the plant are at the present time building a line north for 1 mile and will connect to five farmhouses on the way. During the present year they will extend the lines both west and south 1 mile and connect to about a dozen more dairy farms.

The power plant is equipped with a 50-hp Fairbanks-Morse suction-type gas producer and gas engine, which drives a 36-kw, 60-cycle, three-phase generator, giving 2300 volts, and a 110-volt direct-current exciter which is belt-connected to the engine flywheel. Two circuits are taken from the switchboard, one for street-lighting and the other for house-lighting purposes. The transformers are of the standard 20 to 1 type, and the secondary emf is therefore 115 volts. The primary voltage of the street-lighting circuit is 2300, while the secondary voltage is adjusted according to the number of street lamps in use. The street-lighting transformer is mounted upon a rack in front of the power house about 15 ft. from the ground. By changing one of the secondary leads of the transformers, different voltages can be obtained, giving a range of from 550 volts to 750 volts in 50-volt steps. This transformer as well as the 20 to 1 transformers was built by the Enterprise Electric Company, of Warren, Ohio.

The current of the street series circuit is kept at approximately 4 amp by means of an adjustable resistance at the switchboard. Forty series-burning 50-watt and one 250-watt clean tungsten lamps are used for street lighting. They are equipped with 18-in. fluted Wheeler reflectors and film cut-out sockets. Each unit is suspended on a straight bracket made of 0.75-in. iron pipe with an iron brace, and extends about 5 ft. from the pole. All lamps are 14 ft. above the street level, and a good distribution of light is obtained.

The lighting contract between the owners and the village fixes the cost of each 50-watt lamp at $15 per year, and specifies every-night service from darkness to midnight. Energy for commercial purposes is furnished at 10 cents per kw-hr., with 10 per cent discount above 50 kw-hr. per month and a minimum charge of $1 per month. Meters are installed for all consumers and owned by the company. Owing to the cheapness of energy and the reliability of service it is expected that before the close of this year three-quarters of the dwellings will be using electric lights. During the present summer the plant has been run every Tuesday during the daytime for electric irons. The Underwriters' rules are followed in all house wiring, and almost all of the consumers use tungsten lamps, thereby obtaining excellent lighting results.

In connection with the power plant the owners have installed in the adjoining room a ball-bearing Sprout-Waldron attrition feed-grinding mill, with crusher and necessary elevator, etc. The feed mill is operated during the light-load hours of the night run and every Saturday during the day. The rate for feed grinding is 10 cents per 100 lb., and during about seven months in the year it nets a very good income.

The coal used in the producer is the grade known as buckwheat anthracite, costing $4 per gross ton delivered at the power house. The coal consumption during the summer months was less than 1 ton of coal a week. During last December the coal consumed was about 6.5 tons. The peak electric load is only about one-third the rating of the equipment, so that the highest efficiency cannot be secured. The cost of oil consumed is about $1 a week. The gross earnings of the plant for December reached almost $200, and they will soon go above this, as more consumers are being obtained every week.

The gas producer plant at Windham is an excellent example of what can be done in a small town where it is desired to use electricity for street lighting and commercial purposes. The owner does all of the work connected with the operating of the plant, except on the all-day Saturday run, when he hires a man to help take care of the feed grinding, from 3 to 5 tons of feed often being handled during this run.

The work of caring for the producer during operation is remarkably simple as compared with that required for a steam boiler. The fire in the producer is poked down and raked before starting in the evening, and fresh coal is added. Air is then forced against the fire with a small blower by a 2-hp gasoline engine. This engine also runs an air compressor for starting the gas engine. The time consumed for the work is from 20 to 30 minutes. The gas is tested by lighting it when the blower is running, and as soon as the gas will burn without going out it is ready to be used in the engine. The valve to the atmosphere is closed and the one to the engine is opened, the engine being started by a few impulses of compressed air in one of the cylinders. After the crankshaft has made two or three revolutions the air is shut off, the starting gear lever is put in its running position, and both cylinders then take the charge of air and gas, the engine accelerating to full speed in a few minutes.

The above represents absolutely all the work done in connection with the producer until starting time the next evening. For a run of only sixteen hours or eighteen hours no attention is required, and continual firing and watching of the water glass are not necessary, as with a steam boiler. There are no tubes to leak and to be cleaned. The owner would not consider returning to the old steam-plant methods such as are followed in nearly all small town plants. Moreover, the coal consumption by the producer is only about one-third the amount required for steam boilers. The gas producer and gas engine form an excellent equipment for the purposes filled by the electric-light plant of a small town.

DESTRUCTION OF BACTERIA BY ELECTROLYSIS.

An illustration of the efficacy of the electric current in the destruction of bacteria is found in some tests made on the electrolysis sterilization of milk by Dr. C. B. Morrey and Prof. F. C. Caldwell, of the Ohio State University, Columbus. As reported by Professor Caldwell before the Ohio Electric Light Association in connection with his paper on the electrolytic purification of sewage, milk was made to flow through a succession of metal vessels, forming electrodes of opposite polarity, so that the current traversed the small streams of lacteal fluid in a number of places, the experiment being thus a thorough one.

In a sample of market milk containing 19,480,000 bacteria per cubic centimeter, an application of 2.5 amp at 2000 volts alternating current for 15 seconds reduced this number 99.97 per cent. Another similar test showed a reduction of 98.7 per cent, and a third, in which the milk was inoculated with diphtheria bacteria in very large numbers, showed their practically complete destruction. Chemical examination of the milk showed no changes which would account for the sterilization, nor could this be accounted for by the heating which took place.

PLANT REPAIRS ON A BURST WATERWHEEL.

The waterwheel shown in the illustration is one of the two runners of a 10,000-hp hydraulic turbine installed in the Shoshone plant of the Central Colorado Power Company. These wheels, 4.5 ft. in diameter, operate at 400 r.p.m. under a head of 170 ft. After eighteen months of

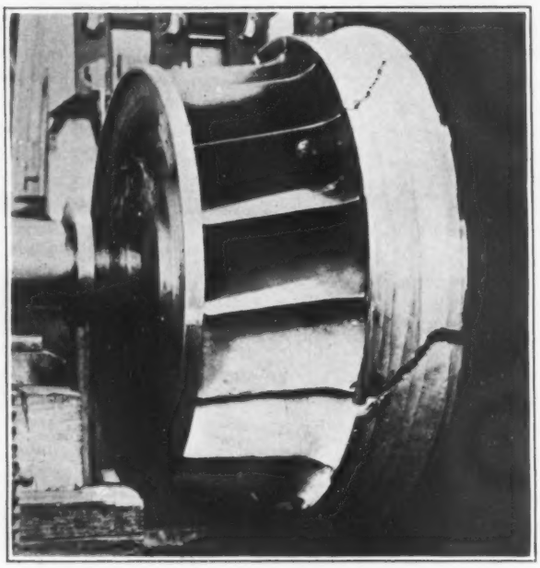


Fig. 1—Cracked Waterwheel Runner Before Repair with Oxyacetylene Flame.

service the runner shown cracked in several places owing to the wearing action of foreign matter in the water, which further reduced the section of the thin metal.

Another curious action was observed in the pitting of the case casting of these same turbines, numerous tiny holes appearing in a plane near the entrance of the water. This

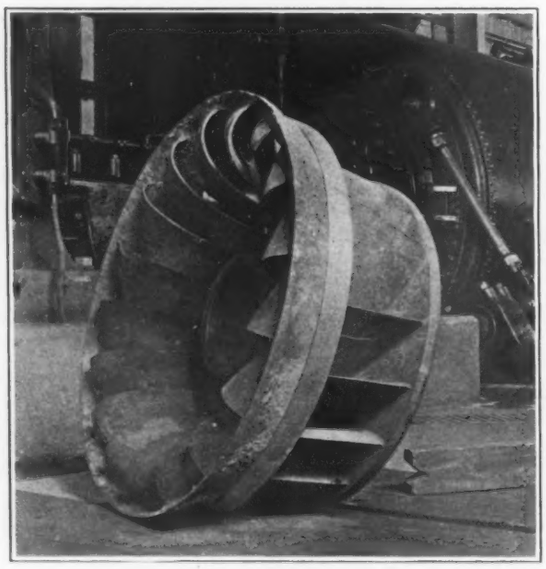


Fig. 2—Runner Repaired by Welding Cracks and Shrinking on Steel Ring.

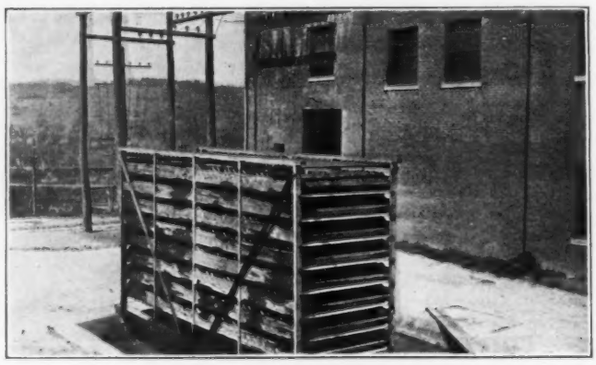
pitting was explained by the presence of oxygen entrained in the water, which, it was believed, thus attacked the metal under the pressure of the penstock. A steel ring 6 in. wide and 0.5 in. thick was later set into the casing at the point where the pitting had occurred, the pitted parts of the casting being channeled out to receive the plate flush with its inner surface. The steel has since remained unattacked by the pitting, but as the latter again made its appearance in lesser degree in the casting alongside the inserted plate, the exact cause of the destructive action is still in doubt.

Cracking of the runner occurred in two places where full breaks were observed, besides numerous little cracks running across the ring in other places. An oxyacetylene flame was used in making the repairs, eighteen welds being required before the job was finished. At the outset it was found that efforts to repair one crack usually resulted in causing one or more new cracks, due to the expansion of the parts. This difficulty was finally solved by preheating the runner on one side while the weld was made on the opposite side. Then the wheel was turned through 180 deg. and the opposite weld completed. The crack openings were filled solid with a mixture identical with the metal in the runner, and the entire ring was built up and turned to a minimum thickness of ¾ in. Outside of this a 3-in. by ½-in. steel ring was then shrunk on and turned down to be concentric with the axis line of the bearings. All the work was carried out with such ready means as were at hand in the plant in the canyon of the Grand River, 12 miles east of Glenwood Springs, Col., the nearest town.

TOWER FOR COOLING TRANSFORMER WATER.

The Connecticut River Transmission Company, of Worcester, Mass., recently installed a cooling tower at its Worcester substation in order to economize in the use of transformer circulating water. At the substation, which is located on the outskirts of the city in the Greendale district, all water used except a nominal amount derived from rainfall is purchased from the city mains. The installation contains seven 1500-kw oil and water-cooled transformers which reduce the potential from 66,000 volts to 13,800 volts in connection with the local distribution of the company for motor service in large industrial plants. On account of the expense of city water and the desirability of running the transformer temperatures as low as possible, the cooling tower shown in the accompanying photograph was built, with the result that the consumption of water has been materially decreased, while the average running temperature of the transformers for the loads handled has been cut down about 20 deg.

The cooling tower consists of a set of racks carrying inclined vanes of wood which are supported above a con-



Cooling Tower at Worcester Substation of Connecticut River Transmission Company.

crete reservoir in the substation yard, the structure being about 17 ft. long, 9.5 ft. high and 3 ft. wide. The reservoir is 21 ft. square and 6 ft. deep, and the tower is supported on two 6-in. by 6-in. wooden sills crossing the reservoir from end to end. The heated water from the transformer coils is carried to the tower through a 4-in. pipe which branches at the top of the tower on the side away from the

sun into two 3-in. horizontal pipes, each of these in turn being tapped at intervals of 6 in. by 1-in. delivery pipes run at right angles to the main feeders. Fifteen delivery pipes are installed, each having numerous ¼-in. holes from which the water is discharged upon the inclined vanes, which are installed in eight tiers. The reservoir is supplied with make-up water through a 2-in. city service with controlling valve. The cooled water from the basin is carried to the substation by two 3-in. underground pipes connecting with a pair of 1.5-in. Baldwin directly connected horizontal centrifugal pumps driven in each case by a 2-hp, 110-volt, three-phase squirrel-cage induction motor running at 1800 r.p.m. The pumps are diagonally cross-connected from the suction side of one to the discharge side of the other, so that either may be run singly on the load or one may be operated in series with the other. The transformers are supplied in sets of three each, and the maximum lift is about 15 ft. The cost of the cooling tower and basin is understood not to have exceeded $400.

INSTALLATION OF SMALL POWER PLANTS IN FEDERAL OFFICE BUILDINGS—I.

By D. F. Atkins and H. M. Price.

IN determining whether the mechanical equipment of a federal building under the control of the Treasury Department should include a power plant for generation of electrical energy for lamps and motors, the following points are given consideration: (1) First cost; (2) whether suitable space is available; (3) difference in cost of salaries for power-plant operation as compared with salaries in connection with operation of a low-pressure heating system; (4) increase in total cost of fuel required for the power plant above that required for a low-pressure heating system; (5) increase in cost of water used on account of exhaust steam wasted to the atmosphere; (6) interest charge on first cost; (7) depreciation charge, or amortization (interest and depreciation are assumed as 8 per cent of the first cost of the plant).

In arriving at the cost of the plant the following figures are used:

Single-valve, direct-connected simple engines and generators, per kw, in place	$35.00
Single-valve, direct-connected compound engines and generators, per kw, in place	45.00
Four-valve, direct-connected simple engines and generators, per kw, in place	45.00
Four-valve, direct-connected compound engines and generators, per kw, in place	55.00
Water-tube boilers and setting, with breeching and stack, per kw, in place	30.00
Switchboard and mountings, per panel, in place	300.00

Piping, pumps, feed-water heater, etc., in place, at 20 per cent of the cost of the boilers, engines and generators.

The estimated cost of labor for operation is generally the most important factor in determining whether a plant shall be installed. For operation of the average small plant in a federal building the following operating force will usually be found sufficient:

One chief engineer, at $1,600 per annum.
Three assistant engineers, at $1,200 per annum.
Three firemen, at $2.25 per diem.
Three coal passers, at $2 per diem.
One extra fireman or laborer, at $2.25 per diem.

In the same building with no electric generating plant the following force will usually be found sufficient:

One chief engineer, at $1,400 per annum.
Three assistant engineers, at $1,000 per annum.
Three firemen, at $2.25 per diem, for seven months in the year.
One extra fireman or laborer, at $2 per diem, for seven months in the year.

In approximating the amount of coal required to heat the building, the amount of radiation, both direct and indirect, is ascertained, the latter being reduced to the equivalent of direct radiation by multiplying it by 3 if a fan is used with the system or by 1.5 if the circulation of air is by natural means. It is assumed that each square foot of direct radiation or its equivalent will condense 500 lb. of steam in a season of 200 days, and that when the boilers are operated for heating only there will be evaporated 7 lb. of water per pound of coal. For buildings in the latitude of New York City a fair average will be 1 sq. ft. of radiation per 100 cu. ft. of the contents.

To approximate the additional amount of coal required to operate a generating plant, the size of the generating units is ascertained as hereinafter described, assuming that the large unit will operate under a fluctuating load varying from one-half to one and three-quarters load sixteen hours a day for 165 days, and that the small unit will operate under the conditions noted above eight hours a day. The steam consumption per indicated horse-power of the engines under the varying loads is taken from the tables hereinafter given, and the total steam consumption in pounds for the two units is reduced to pounds of coal on the assumption that 8 lb. of water will be evaporated per pound of good bituminous coal.

GENERAL ARRANGEMENT OF APPARATUS.

In connection with electric generating plants in federal buildings, all-steel water-tube boilers are installed, if possible, and are designed for a safe working pressure of 150 lb. per square inch, the usual operating pressure being 125 lb. per square inch.

The size of the boiler plant is generally governed by the heating and ventilating requirements, as these are heavier in practically all parts of the country than are the requirements of power for operating the engines. A close approximation of the boiler requirements for direct heating is made by allowing 1 boiler hp for each 7000 cu. ft. of contents of the building.

If the heating and ventilating requirements and space conditions are not the governing factors in determining the number and size of the boilers, the day load and evening load on the generating plant are determined by the method hereinafter described. The day load plus the evening load divided by 2 will give the size of the boiler units from which the best results will be obtained, one boiler being sufficient to carry the full load, with some margin, on the daylight run, and the evening load by slightly forcing the fires. This can easily be done by cleaning the fires toward the end of the daylight run and working up a strong, deep fire for the commencement of the evening load. Three boilers of the size above noted would generally be installed.

The minimum size of water-tube boiler installed is 100 hp. The clear heights which must be allowed from the bottom of the pit to the under side of the ceiling beams to insure a proper installation for the water-tube boilers used by the Treasury Department are as follows:

For boilers of 100 hp to 150 hp	14 ft. 6 in.
For boilers of 150 hp to 175 hp	15 ft. 0 in.
For boilers of 175 hp to 200 hp	15 ft. 6 in.

These boilers are based on 10 sq. ft. of water-heating surface per horse-power and are always equipped with some kind of smoke-prevention apparatus.

It has not been the practice of the Treasury Department to install superheaters, but it is the intention to use them in future plants, as experience elsewhere goes to show that a super-temperature of 100 deg. may readily be obtained, with but little additional fuel expense, by devices in the boiler settings arranged to receive the last pass of the gases on their way to the breeching. This degree of superheat admits of a reduction of 25 per cent in the size of the steam pipes and insures against accidents in engine cylinders due to entrained water in the steam. Moderate super-temperature does not seem to interfere with the proper lubrication of the cylinders.

The boilers are arranged, when possible, to give a short, direct connection to the stack and are so located as to be close to the engine room and convenient to the coal and ash rooms. A firing pit (especially a deep one) is always a detriment and is avoided if possible.

The location of the engine room either directly in front or directly at the rear of the boiler room gives the shortest pipe connections and hence the least friction and condensation in the steam mains. This arrangement of engine and boiler rooms also allows for increase in the boiler, engine and switchboard equipments by lateral extension, giving at all times a neat and compact arrangement of apparatus and one which is economical both in first cost and in operation. Arranging the engines with cylinders on center lines parallel with center lines of boilers and close to partition between boiler and engine room (5 ft. to 10 ft. clearance between wall and cylinder head) further shortens steam and exhaust connections.

SIZE AND NUMBER OF GENERATING UNITS.

The full connected lamp and motor load is ascertained, special attention being given to the accurate determination of the rated horse-power of all elevator motors, as this item is of importance in determining the size of the units. The starting current of elevators is never less than 35 per cent in excess of the maximum running current with direct-current motors, and rises to 200 per cent with alternating-current motors.

Federal buildings in which generating plants are installed have twenty-four-hour service, and no breakdown connection is made with the local lighting companies; therefore the plants are made larger than in commercial practice and never less than three units are installed, generally two large units, each sufficient to carry the peak load, and one small unit to carry the after-midnight load. Usually, with a view to insuring as far as practicable continuous operation, a four-unit plant is selected, comprising two large units, each able to carry the peak load, and two small units, each capable of carrying the after-midnight load.

No unit smaller than 50 kw, and generally none larger than 150 kw, is installed. The reason for the lower limit is apparent, while space conditions, etc., generally forbid the installation of units exceeding 150 kw.

The foregoing are the rough guiding rules. To determine accurately the proper number and size of units within the limits stated, further analysis is made, as follows:

- **Constant load, consisting of**
  - A percentage of the total number of lamps connected.
  - A constant motor load consisting of certain motors likely to be run continuously.
- **Intermittent load, consisting of**
  - Electric elevators, motors for mail lift, ventilating fans, house pump, air compressors, circulating pumps (if used), vacuum cleaning machine, automatic temperature-control apparatus, air-washer motors.

In determining the size of the units the motor-service demand should be analyzed under "day-load" and "night-load" conditions. With the post office operating all night the heaviest demand for energy will be between the hours of 4 p. m. and 10 p. m., while from 11 p. m. to 6 a. m. the demand will be the smallest. The day load may be determined approximately as follows:

- **Day load**
  - Lighting
    - 30 per cent of basement lamps.
    - 20 per cent of post-office workroom lamps.
    - 10 per cent of first-floor corridor lamps.
    - 5 per cent of office lamps on all floors.
  - Motor
    - Constant.....
      - Ventilating fan motors.
      - Circulating pump motor for air washer.
    - Intermittent....
      - Electric elevators.
      - House pump.
      - Mail hoist motor.
      - Air compressor.
      - Vacuum cleaning motor, etc.

The constant motor load can be accurately determined, as it should not be difficult to decide definitely what ventilating fans, pump motors, etc., will be operated more or less continuously.

After the day-load conditions have been thoroughly investigated the load conditions of the evening and after-midnight runs should be determined as follows:

- **Evening load**
  - 70 per cent of all post-office workroom lamps.
  - 30 per cent of all basement lamps.
  - 60 per cent of first-floor corridor lamps.
  - Small motor load for fan, pump or similar service, determined from the plans.
- **After-midnight load**
  - 40 per cent of all post-office workroom lamps.
  - 30 per cent of all basement lamps.
  - 30 per cent of all first-floor corridor lamps.
  - Small motor load to be determined from the plans.

If the day load plus the after-midnight load is equal to or greater than the maximum or evening load, one unit should be selected with full-load rating equal to the day load and one unit with full-load rating equal to the after-midnight load. These two units can then be operated in parallel to carry the maximum or evening load. The rating of the spare unit is made equal to the day load.

If, however, the maximum load is greater than the sum of the day and after-midnight loads, the size of the smaller unit must be equal to the difference between the day load and the maximum or evening load.

As hereinafter stated, the large units must never be less in rating than four times the rated kw demand of all elevator motors which may be in use at one time. When the day load is larger than 150 kw, two or more units, preferably of equal rating, are chosen.

To illustrate the method of proportioning units, assume that the constant lamp and motor day load is 110 kw, and that two electric elevators are intermittently in use, each having a motor rated at 10 kw, and each motor requiring 15 kw to start. The maximum instantaneous load possible under the conditions is 110 plus 15 plus 15, or a total of 140 kw. A 125-kw unit would be selected for this case, as such a machine has an overload rating of 156 kw for two hours. The generator could easily take care of a vacuum-cleaner or other small motor in addition to the load stated.

For another example, assume that the constant lamp and motor day load is 50 kw, and that there are two electric elevators in service, each having a motor rated at 10 kw and requiring at starting 15 kw for each motor, or a total of 30 kw intermittent load. A 75-kw generator would be selected for this service.

In selecting the size of a generating unit which must carry the constant motor and lamp day load and also an elevator load, the size of the generator should never be less than four times the rated kw of all the electric elevators which may be in use at the same time. The relation of the generator rating to the intermittent elevator load must not be overlooked or the voltage regulation will be poor and the lights will blink when the elevators start.

In commercial practice the generator rating is, under adverse conditions, sometimes made only 2.5 times the rated kw of the elevator motors, but the results are bad.

The foregoing methods of determining the generating unit rating are for buildings where the larger unit will not exceed 150 kw. When conditions arise which require the design of a plant involving much larger units, and where perhaps from four to ten elevators are in daily use, it is advantageous to provide and operate two units in parallel for the day load in lieu of one; or one large one and three of one-half its rating sometimes will prove a better arrangement, this depending on the relative proportion of the constant and intermittent loads, etc.

No hard and fast lines can be laid down to govern the size of generating units, but the procedure is substantially as stated.

Types of engines and generators best adapted for certain conditions will receive attention in an article in a later issue.

Central Station
Management, Policies and Commercial Methods

RURAL SERVICE NEAR DAYTON, OHIO.

The Dayton Power & Light Company is at the present time supplying service to four rural districts, from which a very satisfactory revenue is derived. In these towns a total of fifty-four 75-watt series tungsten street lamps are operated on an all-night schedule, water is pumped for the villages, and in one case in addition to the pumping 35 hp in motors is furnished for a grain elevator and feed mill. The communities served are well pleased and are good "boosters." Hardly a month passes without some community soliciting service, now that it is generally known that the company is making extensions to the rural districts. "They do all the preliminary boosting and all the company has to do is to fix the rate and build the lines," said Mr. J. C. Matthieu, commercial manager for the Dayton company, before the Ohio convention, July 19.

"When a community comes to the company for service," he continued, "we place the burden upon its shoulders." In other words, the company puts it up to the local improvement association to give a prospectus of the amount of business to be expected in residence lighting, the number of street lamps the village will contract for on a ten-year basis, etc. The company tries to be as fair as possible to itself and to the community, and does not ask the community to come more than half way. It is the aim to assist new customers and see that they are properly cared for and that the service is right.

A representative reads the meters each month, devoting the remainder of the day to promoting new business and handling complaints. The bills are payable at a local bank.

The street-lighting circuits are cut in and out by means of time switches, which have been found to be very satisfactory. Lamp renewals are cared for by a local man with whom the company has made arrangements to replace all burned-out lamps and to report any trouble occurring to the circuit. Handling the business in this manner cuts down expense and has been found to work out to the very best advantage to the consumers as well as the company.

LOSSES FROM SLOW METERS.

In directing the attention of the small company to the necessity for regular and frequent meter tests and inspection, Mr. John Gilmartin, chairman of the meter committee of the Ohio Electric Light Association, cited the case of one central station having about 500 meters in service one-half of which are comparatively new, the remainder being of an older type. The new meters were found to be in fairly good condition, while of the older meters 15 per cent were slow on normal load. Eight per cent would not run at one-tenth load and 10 per cent would not run at one-twentieth load. Reports obtained from several other companies of approximately the same size have shown similar results. As the normal load of a very large percentage of meters does not exceed 15 per cent or 20 per cent of their rating—and this is especially true since the introduction of tungsten lamps—it is of vital importance that meters be tested at regular intervals. Besides the loss sustained by the company dissatisfaction is encountered when the customer is again billed on his correct registration after the meter has been calibrated.

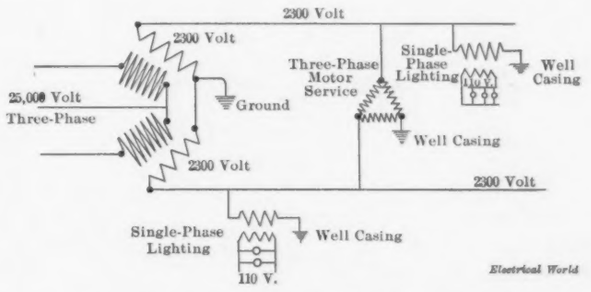
To determine the value of meter tests, the results of each test should be tabulated so that the average accuracy of all meters on the system can be readily ascertained. Assuming the average revenue per meter to be $20 and that the average accuracy of the meters is 95 per cent, it can be readily seen that $20 represents 95 per cent of the energy consumed, and that the company is losing $1.05 per meter per year. From actual cost data obtained by the committee, the average cost of testing and maintaining meters should not exceed 50 cents per meter per year, aside from the first cost of the necessary equipment. The increase in revenue would then not only compensate for the expense of testing but insure against greater losses which might result if the meters were allowed to continue in service without proper attention.

Time between tests should depend upon the type and size of meters in service and the local conditions. A good induction meter in the average residence need only be tested every two years, while the same meter for a commercial customer using a relatively large amount of energy may require testing at least once in every twelve to eighteen months. Commutator-type meters should be tested in periods ranging from three to twelve months, depending on general service conditions.

SUPPLYING ENERGY TO FARM CUSTOMERS OVER ONE WIRE WITH GROUND RETURN.

Arrangements are being made by Mr. John Cavanaugh, superintendent of the Benton Harbor-St. Joseph Railway & Light Company, Benton Harbor, Mich., to furnish central-station service to a number of farm customers over a single 2300-volt primary conductor, with ground return. The effort is, of course, to reduce the cost of construction, and while the 2300-volt circuit will be grounded the 25,000-volt system from which energy is taken, as well as the low-voltage secondaries on the farmers' premises, will be kept clear.

A pair of 25,000-2300-volt single-phase transformers will be arranged in open delta on the supply circuit, the junction of their terminals being carefully earthed. From the other



Grounded Distribution Lines for Farm Service.

ungrounded terminals of each of the transformers parallel single-wire distribution lines will be led off through the farm district to be served. From either of these lines single-phase service will be available by connecting in a transformer between wire and ground, the earth connection being formed by attaching the ground wire to the farmer's driven-well casing. If polyphase service is required for running a large motor, a tap can be brought across from the other single-wire line, completing the three-phase service. Bare copper conductor is to be used, carried on 25-ft. poles. The farmers' 110-volt secondaries will be ungrounded.

COST OF A SMALL CENTRAL-STATION SYSTEM.

In the following tabulation is given the estimated cost of an electrical distribution system for the village of Hyannis, Mass., whose authorities have recently granted permission to the Barnstable Electric Company to install an electric-lighting system. The data are of value in view of the great number of small towns which are yearly considering this class of service. In the town under consideration the association owning the lighting franchise has planned to install a 37.5-kva, three-phase, 2300-volt generator in the existing municipal pumping station, belting it to an engine already in service and utilizing steam available from the boiler plant of the pumping system. The costs given are thus purely for the electrical equipment.

COST OF INSTALLATION.

Generator, exciter, tub transformer and switchboard equipment	$1,369.00
10 miles No. 6 B. & S. weatherproof wire, series incandescent street lighting	1,207.00
10 miles No. 6 B. & S. weatherproof wire for commercial primary and secondary distribution	1,207.00
1 mile No. 4 B. & S. wire, weatherproof, for secondary distribution	147.05
Installation cost of wire, 110,000 ft., at ½ cent per ft.	550.00
150 35-ft. poles, at $5.50	825.00
50 40-ft. poles, at $7.50	375.00
50 45-ft. poles, at $9.50	475.00
Installation of 250 poles, at $5 each	1,250.00
Rental attachment on 200 poles of local telephone company at $1 per year	200.00
250 six-pin arms, including pins and through-bolts, at 75 cts.	187.50
50 four-pin arms, including pins and through-bolts, at 55 cents.	27.50
100 two-pin arms, including pins and through-bolts, at 35 cents.	35.00
2,000 glass insulators, at $25 per 1000	50.00
2,000 pole-steps, at 3 cents each	60.00
300 pairs cross-arm braces with carriage bolts and lag screws, at 25 cents per pair	75.00
100 house-brackets, at 10 cents each	10.00
60 series incandescent street-lighting fixtures, complete with lamp installed on pole, at $7.50 each	450.00
75 kw in lighting transformers for commercial customers, averaging 2.5 kw. each, total thirty transformers, at $35	1,050.00
50 meters, at $10	500.00
Incidentals covering installation of generating equipment and other apparatus	1,000.00
Engineering fees	1,000.00
Total	$12,050.05

Besides the generator, the equipment includes a 1.5-kw exciter, a combination generator, exciter and feeder panel and a constant-current transformer, with operating panel, lightning arresters and incidentals, the remainder of the equipment being for overhead distribution.

CENTRAL-STATION SERVICE IN MINING OPERATIONS.

By T. E. Spence.

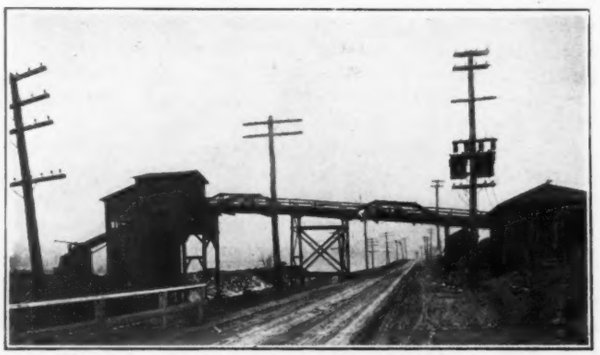
One is inclined to inquire of what interest the use of electricity in coal mining can be to the central station, "for surely," a casual observer is wont to say, "you cannot expect to buy coal, haul it to the central station, burn it, produce energy and transmit it back to the mines cheaper than the mine operator can produce it." It certainly looks that way to the layman to whom coal bin and ash pile appear as the main features in the generation of electrical energy.

It is a well-known fact, however, that the cost of fuel even with transportation added is a relatively less important item in the total cost of energy than the interest and depreciation charges on the investment, unless the load-factor on the system is particularly high. A close study of the load-factor and its relations to energy cost will undoubtedly reveal the interest of the central station in the use of electricity in coal mines within reach of its circuits.

The foremost problems of the mine operator in which the central station figures largely are, first, the cost of production; second, reliability of service; third, investment. The primary operations involved in the production of coal are the mining of coal, its transportation to the foot of the shaft and its elevation. The secondary operations are pumping, ventilation, the operation of breaker machinery for crushing, sizing and refining anthracite coal and a small amount of lighting. Regarding the cost of operation, the rapid introduction of electric power in mines would seem convincing evidence as to the economy of electrification in certain of the above operations; but the operator doubtless has yet to see the wisdom of electrifying the remaining operations.

The cutting of coal is one of the first processes in its production, and careful study of the methods in the anthracite region shows a strong tendency to the use of compressed air. The writer is of the opinion that central-station service can usually be obtained at a rate to show economy in driving the compressor with electric motors. Electric cutting machines, however, are rapidly coming into general use. As regards haulage, after a mine has been developed away from the shaft, it is seldom difficult to demonstrate the saving possible by the employment of electric haulage. It becomes necessary in such cases to make use of some means of mechanical haulage either with locomotives or motor-driven cables in place of haulage by mules.

The use of electricity for draining and pumping is most advantageous, and in nearly all cases electric pumping is



Coal Washery at West Nanticoke Connected to Central-Station Lines.

economical and much more flexible and reliable than either steam or compressed air. The hoisting of coal is perhaps the most serious problem in the application of electricity to coal mines. The difficulty seems to be largely due to the greater investment necessary for an electric hoist and plant as against that of a boiler plant and steam hoist. If, however, central-station energy is available, the changed conditions would be much in favor of the electric hoist. The extreme hoisting peaks and wide variation of demand are of some importance to the central station and should have consideration, as their influence on the transmission system and perhaps on the station may become a source of danger to the service. Various types of electric hoisting systems are now being produced to overcome these conditions, possibly the most promising being the flywheel equalizer system.

The application of electricity to the other operations in coal mining is comparatively simple, and the applications are usually of such a nature as to make the load attractive to the central station. After a careful investigation of the field served by the Luzerne County Gas & Electric Company the writer finds that the load-factor varies from 18 to 67 per cent. The higher load-factors are obtained in mines where the pumping requirements usually cover a period of twenty-four hours daily. The rate used by the above-mentioned company is made according to the demand based on twenty-four hours' daily operation.

One extremely advantageous consideration in the acquisition of such loads is the fact that with central-station energy available the investment for the mine operator is greatly reduced; otherwise an isolated station costing many thousand dollars will be required. It is possible to suppose cases where electrical operation would be desirable and advantageous, but the operator dependent on his own plant may not be abie to take advantage of the saving that could be effected because of lack of working capital. The coal operator has also to meet conditions that require additional power at short notice, and in order to provide for this demand high investment is necessary in a private plant. By obtaining energy from the central station, however, a comparatively unlimited supply is always at hand. As a general proposition the exploitation of this field by the central station is profitable, and it is now fully demonstrated that a central station equipped for all kinds of power demands and located within reach of the mines can offer attractive solutions to the many problems which confront mine operators.

SOME GAS-ENGINE FAILURES AND SUCCESSES.

Recent events at Aberdeen, S. D., in connection with the central station there which is operated with gas engines and producers bring forward again the question of the reliability of producer-gas-engine plants for central-station service. The central station at Aberdeen, S. D., operated by the Aberdeen Light & Power Company, began operations in 1907. It has been notable since that time as being one of the largest central stations in the country depending entirely on producer gas engines. This plant was described in the *Electrical World* of Dec. 30, 1909. Since that time two large gas engines have been added to the equipment, so that the total present capacity is in the neighborhood of 800 kw to 900 kw. For the first few years the plant operated with fair satisfaction to its owners and the public, and the troubles at first seemed to be of a minor nature which in time would be eliminated. The plant grew rapidly, however, and the size of the operating units was increased, the troubles seeming to increase in proportion.

The difficulties in operation at last were found to be so great that in the spring of 1912 the company very reluctantly gave up the idea of making a success of the gas-engine plant and decided to build a steam plant at another location. As the original franchise granted the company in 1907 established a rather low maximum rate, 10 cents per kw-hr., because of the low fuel cost which was anticipated in operating the gas-producer station, the company recently asked the voters of the city at a special election to grant a revision of the original franchise ordinance so as to permit a maximum rate of 12 cents per kw-hr., with discounts according to quantity. Mr. J. R. Cravath, of Chicago, was retained by the city as an expert to pass upon the reasonableness of the company's request. After investigation he recommended that the change be authorized in order that a reliable steam plant may be put in operation as soon as possible to improve the service, and further recommended that after the building of this plant the city make use of its right as given it by ordinance to readjust rates every five years. He favored a discount based on load factor rather than on quantity. The proposed increase in rates, contingent upon the erection of a modern steam plant, was passed at the special election by a large majority.

The operating troubles with the Aberdeen plant seem to have increased with its size. Voltage fluctuations due to temporarily poor quality of gas coming from the producers are very common. Occasionally there is a complete shutdown from this cause. The company apparently has left no stone unturned to save its large investment in gas-engine plant and has employed the best men it could find, but at last has given up the case as hopeless.

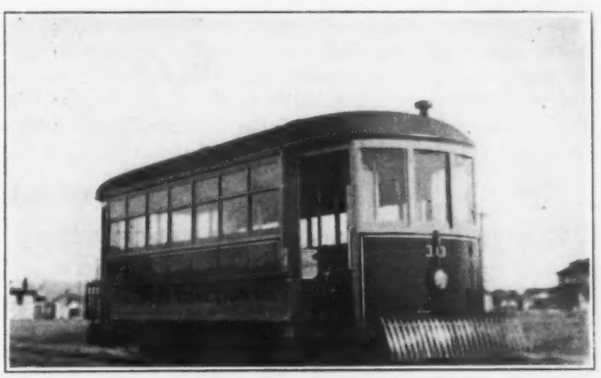
One thing which has tended to increase the operating difficulties at Aberdeen has been the existence of considerable power load which is somewhat fluctuating and a small local street railway load. The gas producers do not seem to be capable of yielding additional gas quickly enough to take care of rapid fluctuations in load, with the result that there is a drop in speed of all the engines whenever there is a sudden increase of load, even though this may be a small percentage of the total. Any attempt to put all the fluctuating load on one engine increases the difficulty to a point where the voltage may fall too low to give good service, or the engine may be stalled altogether. The voltage fluctuation were so serious that even motor users were anxious for an improvement in service.

On the other hand, there are many smaller central stations giving entirely satisfactory service with producer gas engines and operating at fuel costs far below those which could be realized with steam. They seem to have had few of the troubles experienced at Aberdeen. Most of these plants are considerably smaller than the Aberdeen plant and operate at fairly constant loads. That is, the loads change gradually from hour to hour and there are few sudden fluctuations. Among such plants, the operations of which are reported as notably satisfactory, are the central stations at Hoopeston, Ill.; Wagner, Armour, Platte, Lake Andes and Scotland, S. D., all of which employ Munzel engines and producers of the same general types as those at Aberdeen, but with engines of smaller size.

BATTERY-OPERATED STREET CARS AS AN OFF-PEAK LOAD.

In several small communities in the West where the demands of a local street-car service do not justify installation of a trolley system the battery car is opening up a new off-peak load for the central station. The investment in such a system is 15 to 25 per cent less than the cost of trolley equipment up to five or six cars, and the expense of operating is similarly less. Track and plant construction with battery cars is simpler and more convertible, changes in route being effected at the mere expense of relocating the rails. Fairly frequent service can, through means of such cars, be furnished to the public long in advance of the time when a trolley system would be justified, enabling franchises of great future value to be secured and held in this way.

One of the first small battery-car systems to be put in



Storage-Battery Car at Billings, Montana.

service is that of the Billings (Mont.) Traction Company, which now operates two 7-ton, forty-passenger Beach cars over a total of 3.7 miles of track, 2.5 miles of which is in regular use. Twenty-minute service is maintained on the two lines radiating in opposite directions from the business center. One man acts as both motorman and conductor, passengers entering through the front end past a fare box

in which the nickels are deposited, while the carman makes change only. Each car is equipped with 100 Edison nickel iron cells and two 5-hp ball-bearing, chain-driven motors, capable of attaining a car speed of 15 miles per hour. The cars are of light-weight construction, totaling about 7 tons each, 2800 lb. of which is due to the batteries. A separate battery of ten cells is provided for the tungsten car lamps. Each car seats forty persons, but seventy have been carried at one time. The average number hauled by the two cars per day is now 500 at the end of the second month of regular service. On several red-letter days, however, this number has been boosted to 1500 passengers carried. Each car averages 130 miles per day.

The cars are charged at a substation near the end of one of their runs, where a 75-hp, three-phase motor driving a 50-kw direct-current generator has been installed. Energy is purchased from the Billings & Eastern Montana Power Company, the local central station. The principal daily charge is given to the cars between 12 midnight and 6 a. m., when 75 amp is delivered to each car for several hours or long enough to bring the battery up to full charge as shown by the ampere-hour meter, depending on the previous day's use. At the end of each run past the substation, at intervals of forty minutes, a freshening charge of 150 amp for four to six minutes is also added to the batteries, since the nightly charge alone was not found sufficient to run through the entire day. The 50-kw motor-generator set is now run idle continuously during the day, as the operation of starting it at twenty-minute intervals for the freshening charges was found to "blink" the lights badly on the local lighting system. Since its idle running losses are small, the cost of this continuous operation is not excessive and was insisted on by the central station. Tests have shown that the cars require 0.75 kw-hr., as measured on the alternating-current switchboard, for each mile of practical service travel, including all stops. During the first month of service the traction company consumed 5400 kw-hr. and during the second 7500 kw-hr., all of which was practically off-peak demand on the central station. The car-lighting batteries are charged every third night. An interesting feature of the Billings cars has been the performance of the cells under abuse. The batteries can be discharged to zero without damage. One car, for example, was discharged until it barely crept to the substation and was then left stalled with its controllers on for two hours. After being charged it resumed operation as cheerfully and in as good condition as ever. Cars after running clear off the track onto the curb are restored as easily over the street paving as on their native rails. Cells can be overcharged with impunity and have operated satisfactorily, even at temperatures 40 deg. below zero, with the minimum of attention. The company is now building several miles of additional track and has ordered three more cars similar to those now in use. Mr. H. W. Rowley is president of the Billings Traction Company and Mr. John Johnstone is superintendent.

ELECTRICAL EQUIPMENT OF LARGE OFFICE BUILDING AT MUSKOGEE, OKLA.

The recently completed New Phoenix Building in Muskogee, Okla., is an eight-story and basement concrete building, constructed under the Kahn patents. The first floor and basement are occupied by the New Phoenix Clothing Company, and the upper floors by doctors and dentists, and also by several real estate firms.

The electrical equipment of the building is complete in detail. Every possible chance for the utilization of electricity has been taken advantage of. Two 2000-lb. Otis passenger elevators serve the basement and eight floors. Each elevator is operated by a 20-hp motor. The heating is provided for by a 10,000-ft. American sectional hot-water boiler heated by natural gas and supplied with a Connersville vacuum pump, which is belted to a 2-hp Richmond motor. An additional small boiler is used to heat water during the warm weather for lavatory purposes. The water supply is by gravity pressure, there being a 2500-gallon tank on the roof. This tank is filled by a 40-gal.-per-minute pump placed in the basement, which pump is

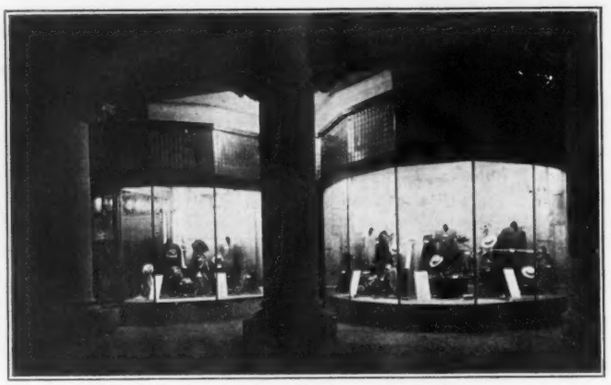


Fig. 1—Illumination of Show Windows.

operated by a Fairbanks-Morse 2-hp, 1200-r.p.m. motor and controlled by an automatic float switch. A circulating ice-water system is installed, the city water being first passed through a Monitor Hygenia filter, then cooled in a large coil placed in an ice chest, and circulated through the system by a Gould centrifugal pump belted to a 1-hp Fairbanks-Morse motor.

As the basement level is below the city sewer level, a small sump is provided for the drainage. The sump is discharged by a straight-piston pump, driven by a 0.5-hp Fairbanks-Morse motor. A Lawson cash carrier connects the basement offices with the main office of the store on the ground floor and is operated by a 0.5-hp Holtzer Cabot

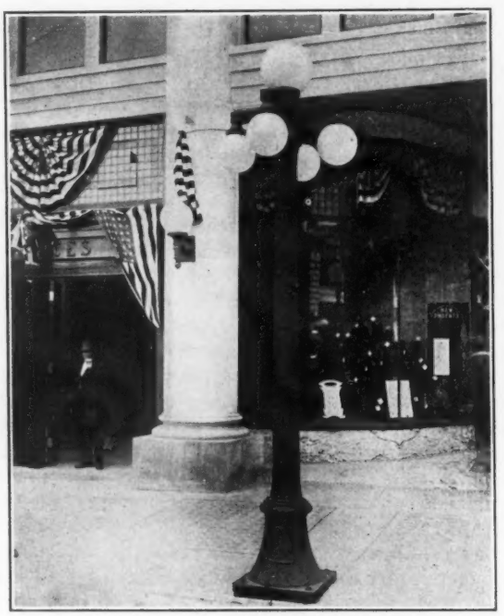


Fig. 2—Five-Lamp Standards on Curb Line.

motor. A truck-type Atwood vacuum cleaner which is used throughout the building is operated by a 3-hp motor.

With the exception of the elevator motors, which are on the roof, and the vacuum cleaner set, which is portable, the entire motor equipment is grouped in the basement in one large room, which also contains the switchboards for lighting and motor service.

Above the first floor the lighting equipment is similar on all floors. On each floor the hall is lighted by six 40-watt lamps in Holophane reflectors, and the fifteen office rooms are lighted by two 40-watt lamps in Holophane reflectors. In addition, each room is supplied with two flush wall receptacles, not controlled by the lamp switch. Feed wires for each floor rise through a wire shaft, which is directly above the switchboard in the basement, alternate floors being tapped on the same side of the 220-110-volt, three-wire system. Energy for lighting and motor service is supplied to the tenants free of charge.

On the curb line are three lamp standards, each containing five 100-watt lamps, while two large brackets flank the entrance, each containing one 100-watt lamp. Behind the large pillar which stands between the two front windows is a unique ceiling fixture containing six 60-watt lamps. The front windows contain thirty 60-watt lamps in X-ray scoop reflectors, and the side windows contain twenty-eight 60-watt lamps in the same kind of reflector. The effect produced in window lighting is indicated in the accompanying illustrations. The lighting of the store on the main floor is accomplished by

Fig. 3—Display Sign by Day and Night.

sixty-five 100-watt lamps in Holophane reflectors placed 12 ft. above the working plane, which are so distributed in single-lamp fixtures as to give approximately 7 ft.-candles at the working plane. On the concrete posts throughout the store are mounted twenty-eight 16-in. oscillating fans and twenty-eight 60-watt lamps in Holophane reflectors. the fans being placed on two sides of the columns and the lamps on the other two sides. Two large fixtures surmount the newel posts of a big stairway in the center of the store, each containing five 40-watt lamps. Lighting under the mezzanine floor at the rear is provided by six 100-watt lamps in close ceiling fixtures with Holophane reflectors.

In the basement, which is somewhat larger than the main floor, being extended under the sidewalks, the lighting equipment consists of eighty 100-watt lamps in Holophane reflectors placed 10 ft. above the working plane, and so distributed in single-lamp fixtures as to give 7 ft.-candles on the working plane. Sixteen posts in the basement are equipped with thirty-two 16-in. oscillating fans and thirty-two 60-watt lamps in Holophane reflectors arranged in the same manner as on the main floor. A switch panel on the main floor and one in the basement control the operation of the store lighting.

Recently there was put into operation on the roof of this building a sign which, it is claimed, is the largest in the Southwest. This sign represents a skyrocket which shoots up from behind the building, curves over the words "New Phoenix" and bursts at the cornice, showering stars down the side of the building and ending at the top of a large vertical sign reading "Clothing." There are three shots of the rocket, the first bursting into red stars and showers, the second into white and the last into green. The flashing device is so arranged that there is one instant when all lamps are lighted, and six seconds when the entire sign is dark. The sign structure is 50 ft. wide, and the words "New Phoenix" are in 5-ft. letters and "Clothing" in 30-in. letters. The showers are 35 ft. long and the vertical sign 28 ft. long. The entire display is double-face, containing 2618 4-cp, 11-volt tungsten lamps, in addition to which there are approximately 1500 color caps for the red and green effects. The sign was designed by Mr. Norman B. Hickox, manager of the new-business department of the Muskogee Gas & Electric Company, and was built by the Greenwood Advertising Company. The flasher was made by the Reynolds-Dull Flasher Company, Chicago, Ill.

Electrical energy for 220-volt, three-phase, 60-cycle motors and 220-110-volt, 60-cycle lighting is supplied from the mains of the Muskogee Gas & Electric Company.

Wiring and Illumination

ECONOMICAL STREET-LIGHTING WIRING ARRANGEMENT.

The Worcester (Mass.) Electric Light Company installed a number of trial circuits of 4-amp, 75-watt tungsten series incandescent lamps a few months ago in connection with the illumination of outlying districts of the city. In order to economize in the feeder investment for this work, Mr. Fred H. Smith, superintendent of the company, devised a plan by which energy for the operation of each circuit is derived from the regular 2300-volt, single-phase commercial service of the plant. Each circuit of incandescent lamps contains from fifty to seventy-five lamps looped through a suburban zone from a constant-current transformer located in a pole box in the immediate neighborhood of the lamp district. The constant-current transformer is connected across the 2300-volt line, one side being fused and the other side connected through a solenoid switch, the actuating coil of which is in series with one of the company's regular street arc circuits passing the transformer case.

The incandescent service is thrown on automatically at the time the regular arc service is switched into operation. The plugging in of the arc lamps permits current to pass through the solenoid switch coil in the pole box, thereby

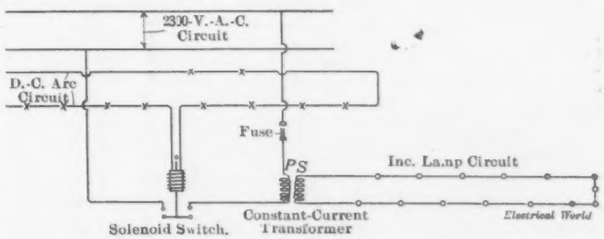


Diagram Showing Street-Lighting Wiring Arrangement at Worcester, Mass.

closing the contacts of the local constant-current transformer primary and starting the operation of the series incandescent lamps. In order to keep the incandescent circuit constantly in service regardless of the current fluctuations and regulation of the arc lamp circuit, a pole piece is installed in the core of the solenoid switch, so that the plunger is held firmly against it as soon as a starting cur-

rent is passed through the arc circuit and coil. In the morning when the arc circuit is cut off the incandescent service remains on until an operator at the distributing substation utilizes alternating current to demagnetize the solenoid core and permit the plunger to drop and break the incandescent circuit. The solenoid switch is of the oil type. Fourteen incandescent circuits of this type are now in operation at Worcester, the load on each varying from 4 kw. to 10 kw. The effect upon the 2300-volt lines has been negligible, and by the use of the automatic switch, which is built for high-potential operation, no patrolman is required to handle the incandescent switching. The system has operated with the highest reliability and has saved the company a considerable investment in underground conduits, ducts and feeders, besides eliminating an expensive switchboard installation at the main distributing center.

HEIGHT OF ARC LAMPS IN CHICAGO.

At a recent meeting of the Chicago City Council's committee on gas, oil and electric light the question of arc-lamp heights was discussed in view of the information furnished by a report submitted by the Chicago Illuminating Society. The society recommended that the 25-ft. height required by ordinance be changed to 30 ft., setting forth that the light from the 1000-cp flaming-arc lamps would be better diffused and further above the line of vision of pedestrians approaching the lamps.

Ornamental Iron Post Adopted by Chicago.

Mr. Ray Palmer, city electrician, presented a report replying to the points made by the illuminating society and in conclusion recommended that the proposed height be maintained at 25 ft. in the outlying residence districts when the underground distribution system was employed and at 22 ft. when the distribution system was overhead. He informed the committee that the proposed height of the new lamps was above the original heights of from 18 ft. to 20 ft., owing to the increased intensity of the light, and that the distribution of light would be the best obtainable when the lamps were spaced at 150-ft. intervals. The city electrician's recommendations were accepted by the committee as final. Mr. Palmer also informed the committee that recently the electrical department had found that the density of trees in some residence districts was such as to shade a large percentage of the space between lamps if the flaming-arc lamps were employed at the height and spacing proposed, and that the overhead distribution system construction was a problem. In view of this fact he had decided to wire the old gas lamp-posts and install an underground 80-cp tungsten lighting system, putting 160 lamps on a circuit.

At the close of the discussion on lamp heights, Mr. Palmer submitted the approved design of ornamental iron lamp-post and bracket for the committee's further suggestions. The design in its final form is shown in the illustration. It will extend 28 ft. above the ground and the lamp will be swung on an ornamental bracket 30 in. from the axis of the post.

ILLUMINATING A MODERN OFFICE BUILDING.

By William S. Kilmer.

Aside from the proper quality and quantity of illumination necessary for a well-appointed office area, the illuminating engineer has very little opportunity to extend further the application of his art on account of the more or

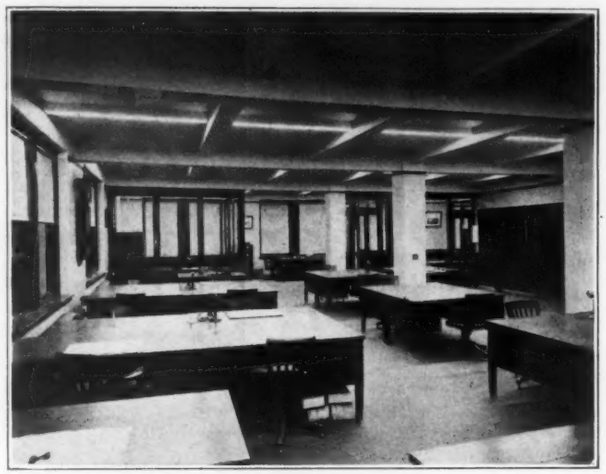


Fig. 1—General View of Seventh Floor.

less ordinary commercial line of lighting fixtures. This article treats of an installation in the building at the corner of Madison Avenue and Forty-first Street, New York City, which has caused no little comment for reasons herein described.

Among various predetermined results it was decided that no localized illumination would be required during working hours for any single limited portion of the various floors, but the general illumination had to be sufficiently high to accommodate all working surfaces. The character of the work on ten of the twelve floors containing the installation in question is identical, namely, clerical and office routine. A typical photograph of one of these floors is shown in Fig. 1. The photograph is a time exposure of this equipment by night.

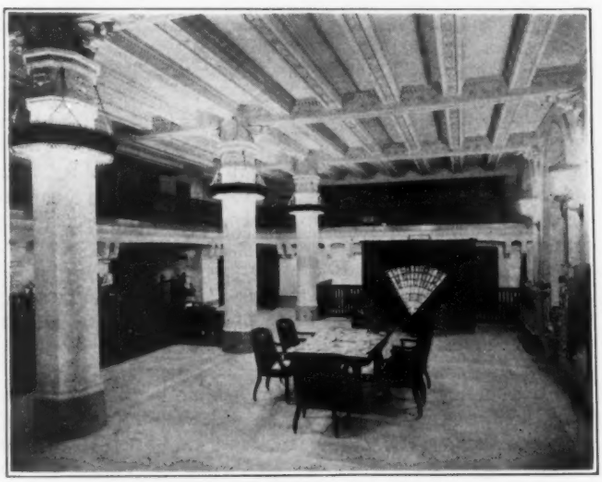


Fig. 2—Lighting of Main Floor and Display Room.

The arrangement and harmony of the system can readily be seen from the photograph. The ceiling measures 12 ft. in height and is divided into squares or bays formed by the arrangement of the beam construction. On a center line of each bay running directly across the building is installed a 6-ft. section of inclosed Frink "trough" reflector. This is shown in detail by Fig. 6. The light source used in this

fixture and in all units described in this article is the 25-watt tungsten "Linolite" lamp. Six lamps joined end to end continuously in each fixture comprise the unit in each bay. The reflecting surface is composed of a series of strips of rippled glass with a mirror backing, over which is placed a coating of baked enamel, rendering the depreciation of the reflecting surface equal to the useful life of the entire installation. Owing to the flexibility of the method of arranging these mirrors, it is possible to obtain the exact distribution of light required for the particular requirements of the installation. This is a feature which is seldom possible without a prohibitive expense with molded reflectors. To reduce the intrinsic brilliancy of the light source and to a certain extent tone the color, prismatic albuminal alabaster glass was used at the bottom and formed the door necessary for easy access to the fixture for lamp renewals. The exterior housing of this fixture is finished in baked white enamel with nickeled door trimmings. The fixture is installed and adjusted by means of lock nuts on the nipple extending from the outlet box through to the interior of the wiring trough.

The results of an illumination test show practically an exact check on the predetermined standard. The section through the area where the test was made is shown in Fig. 3, the plane being on a level with and on the desks. The values obtained are shown in the foot-candle curve, which is in direct relation to this section. It will be noted that the average illumination is 3.5 ft.-candles, with a maximum of 4.5 and a minimum of 3.3. The building up of this illumination at either end is due to the high coefficient of deflection from the side walls. Applying these results to this area for a concrete summary, an efficiency in effective lumens per watt of 2.7 is obtained.

When essential, variations in this distribution and intensity can be obtained from the method of control. At each of the posts in the center of the area is a three-gang arrangement of switches, lighting opposite sides or center. As two of the sides of the building are open to daylight on dark days, it is necessary only to light the rear portion of those nearest the inclosed side. In case only one or two persons are required to work at night floor plugs are provided for portables, if ceiling units are not used.

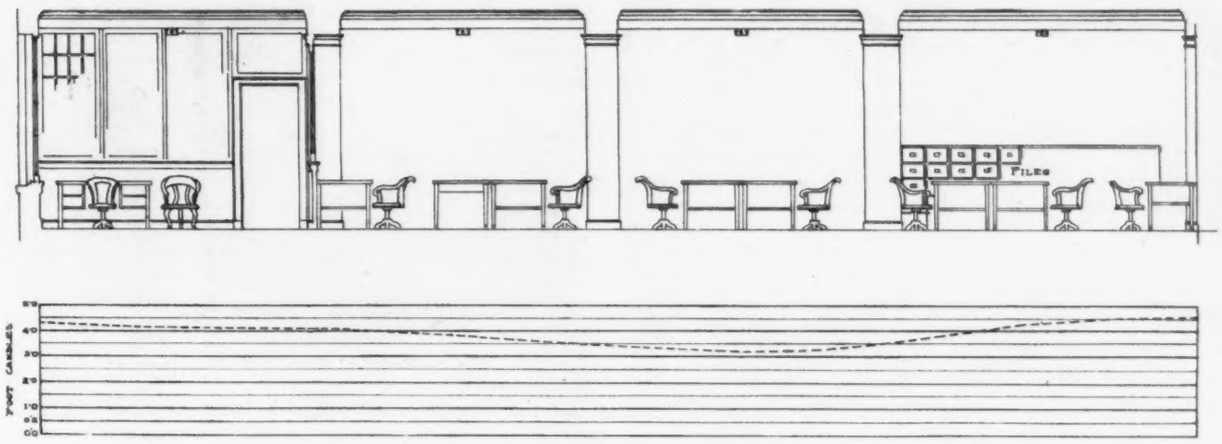


Fig. 3—Elevation and Distribution Curve of Illumination on Seventh Floor.

The remaining two floors of this building required an entirely different treatment. The main floor in Fig. 2 is used for a display-room and retail department of the organization. Although the entire building is of Gothic architecture, this floor and the floor occupied by the executive offices, Figs. 4 and 5, show how, on a more elaborate scale, the dignified and beautiful effects of this period may be applied to a commercial building.

A decorative ceiling is shown on the ground floor, which, of course, required partial illumination. This was obtained from a "semi-indirect" octagon unit supported on each of the three columns. The general principle of interior construction is the same as shown in Fig. 6, aside from the change of angles and double arrangement of reflecting surfaces necessary for both the downward and upward reflection of light. The illumination from these units is

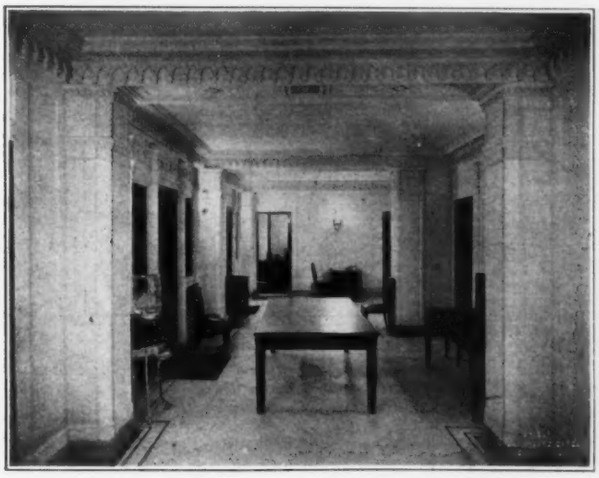


Fig. 4—Corridor of Floor with Executive Offices.

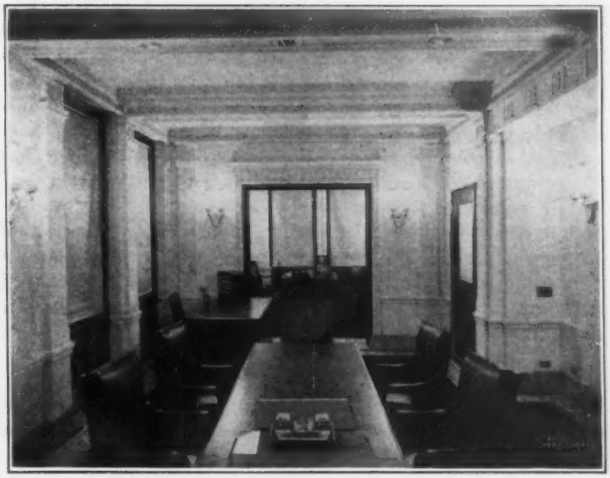


Fig. 5—Lighting of Executive Offices.

also assisted from the Gothic lanterns installed on the side walls of this area. The surfaces here do not require an intensity greater than 2 ft.-candles, which is obtained and is very harmonious with the general scheme. In the executive quarters an average illumination of 2 ft.-candles in also maintained. The directors' room and the private office of the president are shown in Fig. 5. The corridor of this floor is shown in Fig. 4.

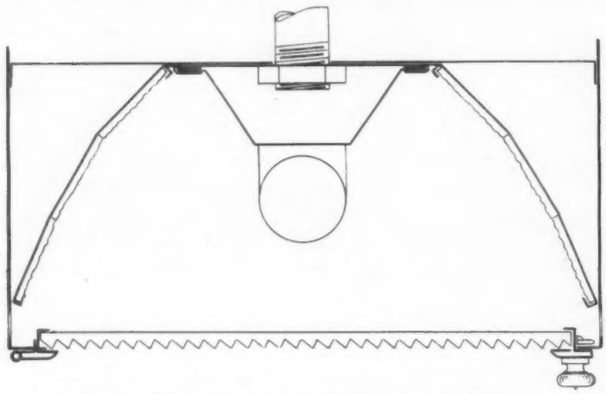


Fig. 6—Detail of Trough Reflector Used on Ceiling.

A SIMPLIFIED ILLUMINOMETER.

By Clayton H. Sharp and Preston S. Millar.

There exists a demand for a photometer adapted for casual use in the measurement of illumination intensities. In order to meet the demand, convenience, simplicity and portability are required in combination with a reasonable degree of precision and reliability. As a secondary requirement such an instrument to an unusual extent should be proof against the more probable errors to which amateur photometry is liable. For there are few if any branches of scientific measurement which are more liable to error through neglect of fundamental principles than is photometry. As photometers are rendered simple and become available for use by those who do not make a serious study of the subject, it is essential that the design be such that as far as feasible correct operation shall be necessitated, little being left to the observer's care beyond manipulation in accordance with a prescribed routine. In this way instrumental difficulties may be minimized, even though it is impossible to simplify the general problem in so far as it is external to the instrument. Wherefore it remains true that important photometric work requires expert attention and should be left to those who by experience and training are competent to deal with it; still a simple illuminometer may be very useful in less important work, and by the exercise of care may be employed by the relatively inexperienced operator in a way which may add important information regarding lighting conditions.

PHOTOMETRIC EQUIPMENT IN GENERAL.

For the measurement of illumination intensity elsewhere than in the laboratory there is required, besides the photometer, which includes the comparison lamp (a) a source of electrical current which is reasonably constant, and (b) some means of regulating the supply of current to the comparison lamp. In this class of work the source of current supply has usually been either small storage batteries or dry cells. Voltmeters, ammeters, Wheatstone bridges and potentiometers have been employed in measuring the current supplied to the comparison lamp. Usually the battery and the measuring instrument have been separate from the photometer, often being combined in one instrument case. Sometimes these have been built into the photometer, thereby increasing its bulk and weight undesirably. In a recent type of instrument a Wheatstone bridge has been built into a small photometer, adding greatly to the simplicity and portability of the complete outfit, leaving only the battery to be carried separately.

Fig. 1—Model of Simplified Illuminometer.

In the illuminometer which is here described the effort has been made to simplify the construction and operation of the instrument, to reduce its dimensions and to make it largely self-contained. To this end all parts are incorporated in the instrument case, except only the battery, which may consist of two dry cells carried in the pockets of the observer or supported over his shoulder by a strap.

DESCRIPTION OF ILLUMINOMETER.

A general view of one model of the instrument is given in Fig. 1, with a plan shown in Fig. 2. The dimensions are 5.75 in. by 3 in. by 2.25 in. The principal features as indicated on the plan are as follows: a is a seasoned miniature tungsten lamp equipped with a reflector and inclosed in a compartment the interior of which is painted white. This illuminates translucent glass g_1 through a diffusing medium g_2; b is a translucent glass constituting one photometric surface illuminated by light from lamp a through window g_1; c is a variable diaphragm (Fig. 3) for regulating the brightness of the photometric surface b.

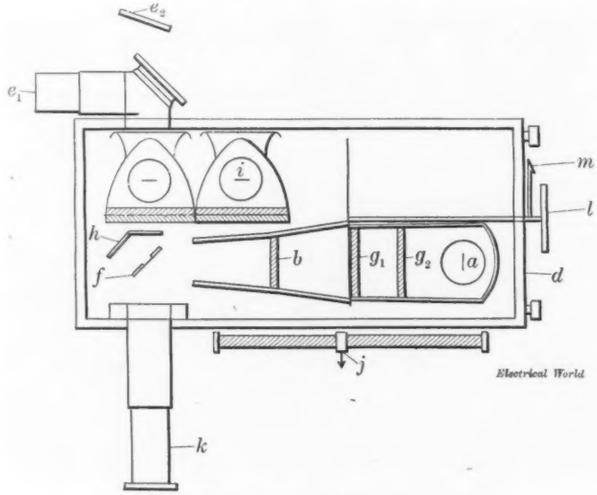


Fig. 2—Plan of Simplified Illuminometer.

As the diaphragm is revolved the size of the aperture is varied, thus exposing more or less of the uniformly illuminated surface g_1. This method of regulating the light from a comparison lamp is an old one, although the design of the circular variable diaphragm is new, having the advantage that it provides a circular scale, in extent almost

360 deg., the characteristics of which may readily be varied to suit the requirements. In this case the design has been made such as to produce a substantially uniform percentage variation throughout the scale. The diaphragm is actuated by a rod on the other end of which is a knob *l*, to which is attached a pointer playing over a circular scale calibrated directly in units of light intensity.

e_1 is a rotating elbow tube containing a translucent test plate upon which is received the light flux to be measured. This is viewed through a 45-deg. elbow mirror. The tube, in one end of which the test plate is affixed, may be inverted, the test plate being exposed at the outer end for illumination work and being screened at the inner end for candle-power work. e_2 represents a detached test plate which may be used as an alternate equipment in a very important class of field work, where it may be found more suitable than the attached test plate.

Fig. 3—Variable Diagram.

f is the photometric device. This consists of a very thin glass mirror in which a small central aperture is provided by removing the mirroring. Placed at 45 deg. to the line of view, it brings portions of photometric surfaces e_1 and *b* into juxtaposition, forming a field similar in appearance to the well-known simple comparison Lummer-Brodhun photometer. This photometric device is a slight modification of similar devices, being superior in that the use of extremely thin glass obviates liability to a confusing optical ghost which is usually encountered in such devices.

h is a frame holding two absorbing screens which are optically light and dense respectively and which may be rotated about photometric device *f* and introduced in either axis to reduce the test light or the comparison light as desired. These amplify the range of the photometer to practically any desired degree.

j is a variable rheostat provided for the regulation of the comparison lamp *a*. To the sliding contact piece is attached a pointer which plays over an equal-part scale.

i is a seasoned miniature carbon lamp completely inclosed within a diffusing reflector, the front of which is covered by a light-blue diffusing glass. The lamp is wired in parallel with the tungsten comparison lamp *a*, both being controlled by rheostat *j*.

This lamp with its inclosing reflector is ordinarily in the position indicated by the continuous lines in the plan. When desired it may be moved to the left, obstructing the light from test plate *e* and substituting as a photometric surface its diffusing glass.

k, the ocular tube, as well as the rotating tube containing the test plate *e*, may be stored within the box when not in use.

METHOD OF ASSURING CONSTANCY OF COMPARISON LAMP.

The unique feature of this illuminometer is the means taken to determine the adjustment of comparison lamp *a* to its standard condition. Fig. 4 shows characteristic curves of variation in candle-power with variation in volts applied to untreated carbon, treated carbon and tungsten-filament lamps. As is well known, the tungsten-filament lamp, because of its positive temperature-resistance coefficient, varies less in candle-power with a given change in voltage than does the carbon-filament lamp. Therefore if a tungsten and a carbon lamp are in photometric balance at a given voltage, they will no longer be in balance if the voltage is changed. Advantage is taken of this characteristic to employ a carbon-filament check lamp in the photometer as a means of indicating the correctness of the voltage applied to the tungsten comparison lamp *a*. The carbon lamp is operated at a relatively low temperature, its reddish light being corrected by a light-blue glass in order to make it readily comparable to that of the tungsten lamp. Under these conditions it is very sensitive to voltage variations and its period of constancy or useful life as a standard is relatively long. If the photometer be so adjusted in calibration that photometric balance between the tungsten and the carbon lamp is obtained, the correctness of the adjustment of the comparison lamp may be determined at any time by testing for photometric balance. If found incorrect, manipulation of rheostat *j* will readily secure the standard condition for the comparison lamp. The first question concerns the sensibility of this method of control of a comparison lamp. Fig. 4 indicates that when the candle-power of a tungsten-filament lamp operated at normal efficiency changes 1 per cent, because of a change of impressed voltage, the candle-power of a treated carbon-filament lamp operated at normal efficiency will change 1 5 per cent, and that of an untreated carbon-filament lamp will change 2 per cent. Practically one might infer from this that with an insensitive photometric device the tungsten lamp candle-power can be regulated to 1 per cent, employing an untreated carbon-filament lamp, while with a fairly good photometric device similar regulation could be attained with a treated carbon-filament lamp. By operating the carbon lamp at a low efficiency a greater difference in candle-power characteristic is obtained than that indicated in Fig. 4. The method becomes therefore more sensitive as the carbon lamp is operated below normal efficiency. In work with the instrument no difficulty has been encountered by various observers in regulating the candle-power of the tungsten comparison lamp to within 3 per cent, as the result of a single observation. A scale is provided in connection with the adjusting rheostat *j*, so that when it is desired to make closer adjustment a number of settings may be made and noted upon the scale with a view to establishing the lamp at the mean of the settings. With such operation it is entirely feasible to obtain all precision desirable in this class of work in establishing and maintaining the correct candle-power conditions for the comparison lamp.

Attention is drawn to the fact that in establishing the correct candle-power of the tungsten lamp a photometric surface illuminated by the carbon check lamp is substituted for the test plate in the photometer field. In so far as errors are involved in personal peculiarity of an observer

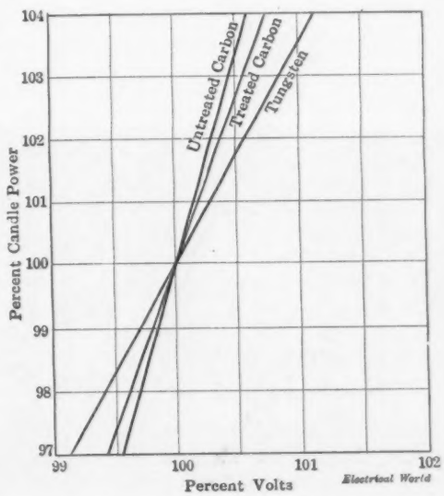


Fig. 4—Curves Showing Variation in Candle-Power with Variation of Voltage.

this substitution method tends toward compensation, although it does not obviate difficulties due solely to color differences. With any photometer calibrated against a standard lamp by observer A, erroneous results may be obtained when used by observer B, because either of physiological differences or differences in mental processes as a

result of which observer B may consider the photometric field to be balanced when one photometric surface is brighter or less bright than was considered correct by observer A. In this illuminometer such differences (except where due to color) are eliminated. In calibration by observer A the photometer is so adjusted that under certain conditions the photometric surface illuminated by carbon check lamp *i* is considered by observer A to be as bright as surface *b*. The photometer is to be used by observer B, who, let us say, requires the central portion of the photometric field, which is usually the test-plate surface, to be brighter than is normal by, say, 3 per cent in order to secure a satisfactory balance. The first operation in using the instrument is to introduce the carbon check lamp in the photometric axis and regulate the tungsten comparison lamp *a*. Requiring the central field to be 3 per cent brighter than normal, this observer will adjust the tungsten comparison lamp correspondingly low. After removing the carbon check lamp the observer will proceed, always adjusting so that the central portion of the field shall be 3 per cent brighter than normal. As, however, he is operating the tungsten comparison lamp too low by this amount, his personal equation will not result in error in the ultimate measurement, as it would in the use of other photometric apparatus.

In calibrating the photometer against a standard lamp the procedure is as follows: Test plate *e* is illuminated to a known intensity and the variable diaphragm *c* is adjusted until the pointer attached to knob *l* indicates a corresponding value upon the scale of illumination intensities. The current supplied to lamps *a* and *i* is then adjusted until photometric balance is secured. Carbon check lamp *i* is then introduced in place of test plate *e* and settings are made to determine the setting of diaphragm *c* necessary to secure photometric balance between the surfaces illuminated respectively by lamps *a* and *i*.

When the photometer is employed in a test the diaphragm is set at the above va'ue and comparison is made between lamps *i* and *a* to check the adjustment of the latter.

SPECTACULAR ILLUMINATION AT PORTLAND, ORE., DURING ELKS' CARNIVAL.

For years the carnivals held by the Grand Lodge of the Order of Elks have always been attended by more or less spectacular electric illumination on the streets through which the parades passed. This year the carnival was held

Illuminated Arch at Elks' Carnival.

on the Pacific Slope during the week July 8-13, Portland, Ore., being the city honored. The main streets in the business section of the city were festooned with incandescent lamps and spanned at intervals with huge wooden arches painted white and decorated with appropriate plaster models. Between arches large wooden pillars were arranged along both sides of the street and at night the arches and columns were outlined in lighted electric lamps. During the week also the floats used for the Rose Carnival and described in these columns a month ago were pressed into service, much to the pleasure of those who traveled many thousand miles from all parts of the country to be present at the gathering.

Letter to the Editors

DEPRECIATION OF POWER-PLANT EQUIPMENT.

To the Editors of Electrical World:

Sirs: Opinions differ considerably as to the proper charge to make for the item of depreciation in power-plant equipment. Some contend that as long as any part of the machinery performs its functions satisfactorily and has been kept in a good state of repair it has the same monetary value to the owner as when purchased. Others assume its useful life to be anywhere from ten to twenty-five years and charge off from 10 down to 4 per cent annually, depending upon opinion as to the probable life of the machine in question. Then, again, there are some who believe its usefulness is lessened from year to year in an increasing proportion and consequently increase the percentage charged off accordingly.

While there are, no doubt, both pros and cons to all of these methods, a careful analysis of the subject will show that the term depreciation consists of two commonly accepted component factors. The first of these might be called decrepitude. It covers the gradual wearing out of the machine resulting from the effects of usage and old age. Such wearing out cannot be overcome by current repairs and will eventually result in ending the useful life of the apparatus and necessitate its replacement in its entirety. Very often its life can be extended by good care and attention, and on the other hand it may be shortened considerably by abuse and neglect. The proper charge, therefore, to make for decrepitude depends largely upon how the machine or equipment is handled, and how often it can be thoroughly inspected and overhauled.

The second factor is obsolescence and takes into account the reduction in the value of any apparatus because of advances in the art whereby otherwise serviceable machinery becomes comparatively uneconomical for further use. Of the two factors this is the most disturbing one in that it often has the effect of reducing the estimated economical life of many parts of the equipment below that which otherwise would be brought about by age and general wear and tear.

It is evident, therefore, that decrepitude is a variable factor depending upon operating conditions, while obsolescence entails the necessity of accumulating sufficient funds to replace the unit when it must go out of service. The former is taken care of as far as possible by current expenditures from month to month, but the latter must be met all at once and may be designated as deferred maintenance. The total amount of depreciation to be charged against any part of an installation must equal the first cost of such part plus the cost of its installation and removal. From this total any salvage obtainable for the part when discarded should, of course, be deducted. A certain proportion of the balance should be charged off annually; whether it is in equal or gradually increasing amounts, as the machine gets older, may be optional. To be profitable, therefore, each part of the equipment must earn sufficient money to guarantee a certain interest on the investment and in addition be able to provide a sinking fund at the end of its life equivalent to its total initial cost. The latter provision would not hold, naturally, in case the machine or equipment became obsolete while yet quite new because of the development of improvements in its design or operation.

Pittsburgh, Pa. Everard Brown.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Phase Advancer for Non-Synchronous Machines.—ARTHUR SCHERBIUS.—An illustrated description of the phase advancer of Brown-Boveri & Company. The rotor current of the main motor is conducted to the commutator by the brushes (Fig. 1). The winding, which is of the usual drum type, lies in holes in the laminated core. The absence

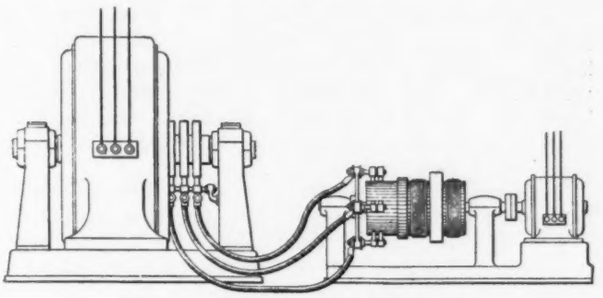


Fig. 1—Elevation Showing Connections.

of any fixed part is striking and is, in fact, one of the main characteristics of the machine. As the field magnetism is produced by the armature current itself there is no need of windings on the stator. This fact led to the idea of combining the stator with the rotor. Both theory and tests supported this idea and proved that a mere ring to complete the magnetic circle was sufficient. The stator was, therefore, abandoned and the compensator built with no air space at all. Its magnetic resistance being consequently smaller than that of a normal machine, the generated emf of rotation can be larger at small loads. This means that the center of the circle diagram lies high so that at normal loads the current is already leading considerably. Although a leading current is very often required (to improve the power-factor of a whole plant), a power-factor of unity is more usually asked for. It is, therefore, clear that some method had to be devised to keep the emf within such limits that the desired power-factor could be obtained. The method applied is simply to so design the compensator that it becomes saturated at the moment when the power-factor reaches unity. As the load increases the rise of pressure will only be small, because the bend in the magnetizing

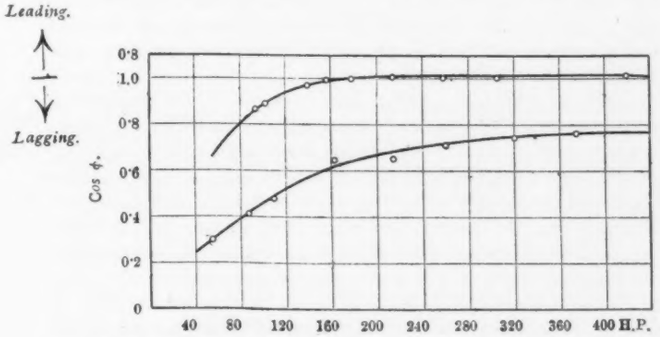


Fig. 2—Curves Showing Power-Factor with and without a Phase-Advancer.

curve has been passed. These machines are in commercial operation. Fig. 2 gives test curves of the power-factor of a 400-hp induction motor running with and without a phase-advancer.—London *Electrician*, July 12, 1912.

Electric Braking of Three-Phase Series Commutator Motors.—KLAUDIUS SCHENFER.—It is well known that a three-phase series commutator motor connected to a network when operating as a generator produces a current of a frequency which is in general not equal to the frequency of the network. The author shows mathematically how this frequency depends on the speed of the machine, its ohmic resistance, the leakage induction coefficient, the magnetic reluctance and the displacement angle of the brushes. Finally some oscillographic curves are given which were obtained in an actual test. They show that the current is the sum of two currents of different frequency, one being the frequency of the network and the other a different frequency. There is agreement between theory and the results of the test.—*Elek. u. Masch.* (Vienna), June 30, 1912.

Transformer Oils.—A. REISSET.—A review of various recent articles on transformer oils dealing especially with the properties required in them, methods of testing and the nature of the deposits which sometimes occur in them.—*La Lumière Elec.*, July 6, 1912.

Lamps and Lighting.

Photometry of Lights of Different Colors.—H. E. IVES.—A long account of an extended investigation on special luminosity curves obtained by the equality-of-brightness photometer and the flicker photometer under similar conditions. The chief new results are as follows: The flicker method is more sensitive than the equality-of-brightness method, where different colored lights are compared. The results by the flicker method are more reproducible than those by the equality-of-brightness method. Decrease of illumination shifts the maximum of luminosity toward the blue with the equality-of-brightness (Purkinje effect), toward the red with the flicker method. Decrease of the size of the photometric fields at low illuminations shifts the maximum of luminosity toward the red with the equality-of-brightness method (yellow spot effect), toward the blue with the flicker method. The relative positions of the two kinds of spectral luminosity curves are in general different. The curves are most different in position at low illuminations with large fields, nearest together at high illuminations and with small fields. They may under certain conditions coincide, and the mean curves of several observers show close agreement in position of maxima and shape of the two curves at high illuminations, although the areas are not the same. The curves obtained by different observers show different positions for each curve and different relative positions of the two for high illuminations. At low illuminations all observers agree in showing the Purkinje and reversed Purkinje effects. As to the practical bearing of these results on photometry, the author thinks that the sensibility and reproducibility of the flicker method are sufficiently greater than those of the other method to recommend its use in all cases where color differences exist and where the question of absolute intensity values is not of the first importance. In the determination of distribution curves of a source, for example, a flicker photometer would be very convenient. A second conclusion is to be drawn from the comparative data by several observers of normal vision. From their differences of reading it is apparent that differences of color vision will always be a serious obstacle to uniform results in heterochromatic photometry. The only practicable escape from this difficulty is to eliminate the need of making such comparisons in ordinary photometric practice; in other words, the aim should be to make all practical photometry the photometry of lights of the same color. Under these conditions it is a matter of indifference what photometer is used or whether the observer has normal color vision. The problem of heterochromatic photometry

hence becomes one for the standardizing laboratory, where secondary colored standards or colored glasses will be prepared for as many practical cases as possible.—*Phil. Mag.*, July, 1912.

Temperature of Filaments.—M. von Pirani and A. R. Meyer.—The authors make some corrections, as follows, in tables which they have formerly given for the temperatures of incandescent filaments at different rates of burning:

	Watts per cp.	Black-Body Temperature, Deg. C.	True Temperature, Deg. C.
Tungsten lamp.....	10.0	1394	1482
	1.0	1947	2105
	0.25	2500	2750
Tantalum lamp.....	10.0	1396	1472
	1.0	1953	2089
	0.4	2285	2468
Carbon.....	10.0	1560	1616
	1.0	2166	2265
	0.6	2357	2472

The first column of figures gives the watts per hefner, the second column the "black-body" temperature in deg. C., and the third column the true temperature in deg. C. Only a few of the figures of the authors are given in this table.—*Elek. Zeit.*, July 11, 1912.

Lambert's Cosine Law of the Emission from Tungsten and Carbon.—A. G. Worthing.—An abstract of an American Physical Society paper. In the investigation of the conduction losses in incandescent lamps an unexpected variation from Lambert's cosine law was noticed. A special investigation making use of the same method, though considerably refined for this purpose, has been undertaken. For a uniformly heated cylindrical tungsten filament viewed normally to its axis the variation from the cosine law is such as to make the average brightness for $\lambda = 0.63\,\mu$ about 3 per cent greater than that of the central portion; for $\lambda = 0.46\,\mu$ the variation is considerably less; for an untreated carbon filament the variation is such as to make the average brightness about 5 per cent less than that of the central portion. A change of temperature for the tungsten shows a definite change in the variation from the cosine law. The light emitted from the edge of the carbon filament was found to be about 20 per cent polarized, that from the edge of the tungsten filament about 60 per cent polarized, in each case in planes parallel to the axis of the filaments. These results for tungsten are similar to results obtained by Uljanin for Pt, Ag and Cu.—*Phys. Review*, July.

Generation, Transmission and Distribution.

Low-Grade Fuel for the Production of Electrical Energy.—F. Bartel.—A paper read before the German Association of Electrical Engineers. While in southern Germany waterpowers are available which would be sufficient to generate all the electrical energy required for all purposes, this is not the case in northern Germany. To use electric power for all possible purposes an aggregate rated equipment of 1,000,000 kw of all central stations would be necessary for northern Germany. This would have to be developed from fuel, and the author discusses the possibility of using low-grade fuels such as bituminous coal (or rather the gas obtained from coke ovens operated with bituminous coal), lignite and peat. The first cost of installation of a station of 4500 kw rating is given as $62.50 per kw for lignite and peat with steam-turbine operation and as $112.50 per kw for lignite and peat with gas-engine operation. The cost per kilowatt-hour generated for a yearly total of 2000 hours of operation is 0.86 cent and 0.89 cent respectively in the central station. If the rated equipment of the station is increased to 15,000 kw the first cost per kilowatt decreases to $30 for bituminous coal, $32.50 for lignite and $37.50 for peat. If the machines are to be used for 2000 hours in a year and if the cost of lignite and peat is $1 per ton, the cost of generating 1 kw-hr. in a 4500-kw station and in a 50,000-kw station is as given in the accompanying table. It will be seen that for the 50,000-kw station the total cost

	Rating of Station.	
	50,000 kw.	4,500 kw.
Number of kilowatt-hours produced.....	100,000,000	9,000,000
Price per kilowatt-hour in station, cents.....	0.568	0.888
Price per kilowatt-hour at main transformer station, cents.....	0.758	1.183
Cost of long-distance transmission per kilowatt-hour, cents.....	0.400	....

of the kilowatt-hour after transmission is 1.16 cents, being therefore less than the cost of the kilowatt-hour in the 4500-kw plant without transmission. The figures of transmission are based on the assumption of a transmission line of 900 km length, with fifteen stations distributed throughout the district, the transmission emf being from 100,000 to 150,000 volts.—*Elek. Zeit.*, July 11, 1912.

Hydroelectric Power in Switzerland.—It is stated that the hydraulic power now available, including that already employed, in Switzerland is about 722,600 hp. Of this about 125,000 hp will probably be used on the federal railways, the electrification of which, it is considered, is only a matter of time.—London *Electrician*, July 12, 1912.

Turbo-Alternators.—The first part of a profusely illustrated article on Curtis turbo-alternators. A description is given of the theory upon which the working of the Curtis turbine is based, and the application of this theory to the building of large turbo-generator sets is dealt with. The design of alternators suitable for direct coupling to these turbines is also described.—London *Electrician*, July 12, 1912.

Traction.

Determination of Tramway Networks.—A. J. Lawson.—The author urges the value of using scale models of tramway systems in order to study the drop with various arrangements of feeders. An example is given of the results obtained. The method consists in building up on a suitable scale a small model system of wires representing the feeder cables and trolley wires and the rails and return cables of the tramway system under investigation. Choosing convenient sizes and quality of wires, it is possible to get in the model the same resistance as in the actual lines. German silver may be used to represent the cables and the trolley wires. The track, however, on account of its low resistance, should be built up of copper wire. The drop of potential (which must be measured by a millivoltmeter) is obtained by means of resistances, representing the cars, connected between the German-silver wires and the copper wires.—London *Electrician*, July 12, 1912.

Traction Problems.—J. Fekl.—A long mathematical paper in which the author discusses the conditions of best starting acceleration, best speed on grades, the weight of locomotive required to make the power a minimum, and the effect of the distance between stations on the weight of the locomotive. In connection with the discussion of these problems the author also deals with the use of motor cars and locomotives.—*Elek. u. Masch.* (Vienna), June 23, 1912.

Gasoline-Electric Automobiles.—J. Simey.—A review of the development of gasoline-electric automobiles with special reference to the systems of Deutz and of the Allgemeine Elektricitäts Gesellschaft. The results obtained with these automobiles are considered to be satisfactory.—*La Lumière Elec.*, June 29, 1912.

Installations, Systems and Appliances.

Generating Stations in Italy.—B. Lecler.—An article giving statistical data on generating stations in Italy. At the end of 1908 there were in operation in Italy 6750 gen-

erating stations, with an aggregate rating of 510,000 kw. This represents an increase during ten years of 200 per cent in the numbers and 500 per cent in the rating. The increase of hydroelectric stations is particularly remarkable, the total rating having increased since 1898 from 47,000 kw to 360,000 kw. Other comparisons are made between the conditions in the years 1908 and 1898.—*La Revue Elec.*, July 12, 1912.

British Central-Station Statistics.—The annual statistical table giving details of the 464 central stations of the United Kingdom, their equipment and development.—Supplement to London *Elec. Rev.*, June 28, 1912.

Electric Heating of Buildings.—A note on the electric heating of buildings in Sweden and Norway. In Norway it has been proposed to heat the churches by electricity, so as to utilize the equipment of the generating stations on Sundays, when most works are closed. The central station in Gothenburg has carried out some experiments with regard to electric heating, it is stated, with most satisfactory results. The energy used was surplus energy, costing the town only 0.134 cent per kw-hr. The tests were carried out in twenty-two offices and private residences and lasted from December, 1911, till April 1, 1912. As the energy in question was available only during the night, the heat, of course, had to be stored in heat accumulators, to be given out during the course of the day. Almost all the temporary users of the electric heating have declared themselves very well pleased with it. It is efficient, easy to handle and control, clean and hygienic. The price seems to vary considerably. For seven of the twenty-two installations the value of the energy has been put at 0.35 cent per kw-hr., for five of them at between 0.54 cent and 0.8 cent, and for ten installations at below 0.54 cent. As a result of these tests, which were carried on during the last exceptionally cold winter, it is claimed that electric heating, properly installed in suitable premises, is economically possible at a price of 0.8 cent per kw-hr. Moreover, the reduced amount of labor, the greater cleanliness and increased hygienic advantages and the reduced risk of fire should be considered. The system, it is expected, will be widely adopted in Gothenburg. The authorities have decided that the surplus energy, as far as it is available and during a minimum limit of eight hours in the twenty-four, can be supplied at $7 per maximum kilowatt used at any time during the year, with an additional charge for the kilowatt-hours used.—London *Electrician*, July 12, 1912.

Electric Cooker.—An illustrated description of an electric cooking apparatus of British design in which the material being cooked is heated entirely by radiation from the heating resistors, which are wound around the periphery of a cylindrical frame.—London *Electrician*, July 12, 1912.

Tariff.—L. ROSENBAUM.—The author makes use of the results of the statistics of the Association of (European) Central Stations for the year 1910-11 to investigate certain factors which have a decisive effect on the financial results of central stations. He then develops a theory of devising a fair tariff and illustrates it by a numerical example.—*Elek. u. Masch.* (Vienna), July 7, 1912.

Oil Switches.—F. MARGUERRE.—The first part of a long illustrated article describing systematic experiments made at the Rjukanfos power plant with different types of oil switches up to 10,500 volts.—*Elek. Zeit.*, July 11, 1912.

Wires, Wiring and Conduits.

Preserving Wood.—W. MANKTELOW.—An article on aczol, a new preservative material for timber. This is a patent compound of metallic ammoniates with an antiseptic acid having no deleterious action on wood or metals. The chemical properties and preservative action of the new material are described.—London *Elec. Review*, June 28, 1912.

Impregnating Wooden Poles.—R. NOWOTNEY.—The author gives results from actual practice on the partial impregnation of wooden poles with tar oil. The results so far obtained are quite favorable.—*Elek. u. Masch.* (Vienna), June 23, 1912.

Electrophysics and Magnetism.

Magnetic and Elastic Properties of Steel.—C. W. WAGGONER.—The author shows that in a series of unhardened steels the relation between the hysteresis loss, intensity of magnetization, maximum susceptibility and the carbon content might have been predicted from the Ewing theory of magnetism and a knowledge of the physical characteristics of the microscopic constituents of such steels. The magnetic hysteresis loss and the maximum strength of unhardened steels vary in the same way with the percentage of carbon. The intensity of magnetization at saturation fields and the maximum susceptibility show the same variation with carbon content as does the ductility of these steels. The maximum percentage elongation due to magnetostriction in a series of annealed steels seems to be a function of the ductility of the steel and may be explained on a basis of the elastic properties of the microscopic constituents composing these steels.—*Phys. Review*, July, 1912.

Electrochemistry and Batteries.

Atomic Weights.—H. PECHEUX.—An account of some determinations of atomic weights of metals by an electrolytic method involving direct comparison with pure silver. The results obtained are in good agreement with those recently obtained by Meaglei.—*Comptes Rendus*, May 28; *La Lumière Elec.*, June 29, 1912.

Units, Measurements and Instruments.

Localization of Faults in Submarine Cables.—C. E. HAY.—An illustrated description of a simple method for localizing in a submarine cable the position of a so-called partial disconnection unaccompanied by an earth fault.—London *Elec. Review*, June 28, 1912.

Meters.—An official statement of the Reichsanstalt admitting for calibration certain induction meters for single-phase, two-phase and three-phase currents and measuring transformers of the Allgemeine Elektricitäts Gesellschaft. The different instruments are described and illustrated.—*Elek. Zeit.*, July 11, 1912.

Meters.—An article giving detailed results of tests recently made in a French testing laboratory on different commercial meters.—*La Lumière Elec.*, June 29, 1912

Telegraphy, Telephony and Signals.

Semi-Bridge Duplex System for Submarine Cables.—J. KAJIURA.—The double-block bridge duplex method of Muirhead has been most commonly used as the best in duplexing long submarine cables. In that method such a number of artificial cable boxes as represent the whole or nearly the whole length of the cable must be provided to obtain a perfect balance. In order to reduce the number of boxes required the author has devised a method for obtaining a balance by using an artificial cable of only half the length of the cable. This is called a semi-bridge duplex and is shown in Fig. 3, in which *A* is a key or automatic transmitter; *B*, a battery; *C*, a balancing rheostat; *D* and *E*, block condensers; *F*, slide condenser; *H*, a receiving condenser; *I*, a receiving instrument; *J*. *K*, *L* and *M*, resistances; *N*, an artificial cable, of which *O* and *P* are the beginning and the end respectively; *Q*, a leak resistor; *R*, resistor, either inductive or non-inductive; *S*, adjustable self-inductor; *T*, *U*, *V*, *W*, *X*, *Y*, *Z* and *A'*, retardation resistors; *B'* and *C'*, adjustable condensers; *D'*, shunt of artificial cables; *E'* line cable; *F'*, *G'* and *H'*, block condenser, receiving condenser and receiving instrument respectively at the distant end of this cable circuit. When a sending battery is applied to one of the block condensers which are interposed at both ends of the line cable the cable throughout the whole length will ultimately attain a

certain potential which is determined by the voltage used, the capacities of the cable itself and the block condensers; this potential is called the "ultimate potential." This is by no means established at once; on the contrary, not only is there always a lapse of time, but this lapse of time differs at different points of the cable. At the two ends of a cable circuit a certain time passes, therefore, before the "ultimate

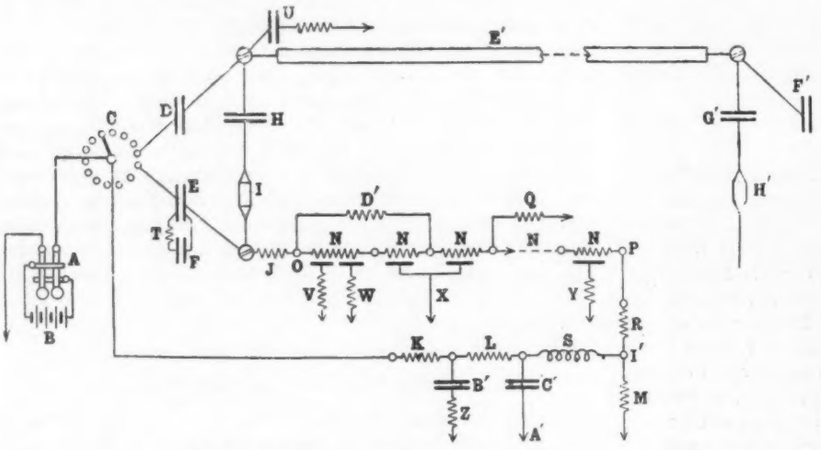


Fig. 3—Arrangement of Semi-Bridge System.

potential" is attained, while there is always a certain intermediate position where the required duration of time is much shorter, and the relation of time and the rise or fall of potential can easily be imitated by a suitable simple means without resorting to artificial cables. This intermediate position, which is called "the intermediate position," is generally at or near the center of the cable circuit. It will thus be seen that, if only such artificial cables as correspond to that portion of the line cable lying between one end and "the intermediate position" be used and a suitable means, which can imitate the relation of time and the rise or fall of potential at "the intermediate position" of the cable, be provided at the end of the artificial cable, an exact duplex balance can be obtained, there being no need for using so much artificial cable as to correspond to the whole or nearly the whole length of the line cable, such as is used in ordinary duplex systems. In the diagram the artificial cables N from O to P correspond to that portion of the line cable lying between its left end and "the intermediate position," and the resistances of the parts of the circuit $KLSM$, branching from the center of the balancing rheostat C, are so adjusted that the potential of I' is equal to the "ultimate potential" of the line cable; and in order to make the relation of time and the rise or fall of potential of I', so connected to the artificial cable, equal to that of "the intermediate position" of the line cable an adjustable self-inductance S and capacities B' and C', with or without retardation resistances, are introduced into the circuit, and in some cases a simple resistance or a resistance having more or less self-inductance is inserted between P and I. The system is in practical use, and the arrangement at the Nagasaki station is shown in a diagram.—London *Electrician*, July 5, 1912.

Automatic Railway Signals.—An illustrated description of the "railophone" wireless inductive system of automatic signaling. Briefly, the arrangements consist of one or more electrical circuits laid along the track it is desired to protect. These are connected with various telephonic and signaling apparatus in the signal box, and may be considered for the sake of clearness to make up the primary circuit of a transformer. The secondary circuit of the transformer is on the train. It consists essentially of two coils of wire wound round the frame of one of the carriages, these circuits being connected to various telephone and signaling apparatus in the guard's van. Experiment has shown that a current passing in such a primary circuit will induce a current in the moving secondary sufficiently strong to allow a telephonic conversation to take place, while it can also, through a sensitive relay, cause a warning signal to sound and the brakes of the train to be applied. In the same way it is, of course, possible for the guard of the train to get into communication with the signal box, and thus to transmit similar warning signals or take part in a telephone conversation. A good deal of the work done under this system is automatic, being affected by the condition of the various apparatus on the train and in the signal box when the former enters that part of the track protected by the circuits.—London *Electrician*, July 12, 1912.

Miscellaneous.

Synthetic Rubber.—C. J. Beaver.—The author deals with the recent advances made by Prof. W. H. Perkin and others in the production of synthetic rubber. Passing from the chemical problems involved, the commercial possibilities are reviewed and the conclusion is reached that the electrical industry is not likely to obtain much relief by the new product and that lower prices will arise in due time owing to new rubber plantations, thus rendering synthetic rubber less necessary commercially.—London *Electrician*, July 12, 1912.

Book Reviews

Testing, Fault Localization and General Hints for Wiremen. By J. Wright. New York: D. Van Nostrand Company. 85 pages, 19 illus. Price, 50 cents net.

Practical suggestions and hints on testing, of the kind popularly supposed to be obtainable only through actual and vivid experience, make up the principal contents of this little volume. The author makes no pretense of having written a treatise and has confined himself rather to concrete suggestions than to theoretical discussions of the how and the why. The book would be improved by the addition of a table of contents and rearrangement of the matter under a few chapter heads.

The American Year Book. Edited by Francis G. Wickware. New York: D. Appleton & Company. 848 pages. Price, $3.50.

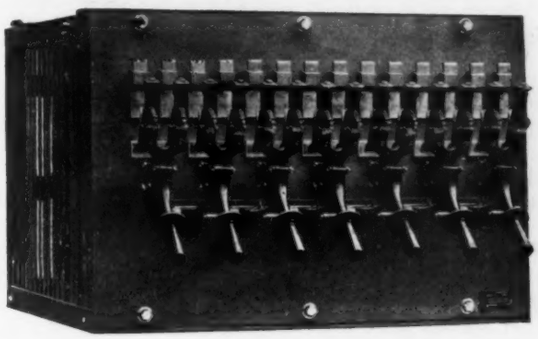
A record of events and progress during the year 1911. The book is a compendium of annual statistics and of reports as to events and progress along various lines of activity and interest. It is divided into nine main sections as follows: Comparative statistics, history and politics, government, economic and social questions, public works and national defence, industries and occupations, science and engineering, the humanities, chronology and necrology. The work, which has been manifestly very extensive, was carried out under a board of thirty-nine supervisors and with the aid of reports from 119 contributors.

The book is strongest and most detailed on the sides of history, government and sociology. It is entertainingly written in a style that is easy rather than polished. The object is evidently to present the facts without prejudice. The volume will appeal as a work of reference to a very large and widely extending class of readers. It would be hard to find an intelligent inhabitant of the United States who could find no interest among its chronicles.

New Apparatus and Appliances

MULTIPLE-SWITCH STARTER FOR LARGE SLIP-RING MOTORS.

A multiple-switch type starter for large slip-ring induction motors has recently been standardized in ratings of from 60 hp to 600 hp by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This type of starter handles rotor currents, and the cutting out of successive steps of



Multiple-Switch Alternating-Current Motor Starter.

resistance is accomplished by means of separate levers. The levers are so interlocked that it is impossible to close the switches except in the proper order. Each switch as it is closed holds the one next to it so that it is necessary to close them in succession. The closing of the individual switches also introduces a time element, thereby preventing a careless and too rapid acceleration of the motor. Auxiliary carbon and copper contacts and a quick, snappy opening action practically eliminate arcing on the main contacts.

ELECTRICALLY OPERATED BASCULE BRIDGE.

The electrical installation on the bascule bridge over the Calumet River near South Chicago, Ill., for the Chicago & Western Indiana Railroad Company presents several novel and interesting features. This bridge is of the Strauss design, heel trunnion type, single-leaf, double-track, 186 ft. long from trunnion to the end of span, and weighs 1,100,000 lb. exclusive of the counter-weight, which consists of slag concrete and weighs approximately 1500 tons. It is one of the longest single-leaf spans in the world, being exceeded only by a bridge of similar design now being installed by the Baltimore & Ohio Railroad over the Calumet River, which will have a movable span of 230 ft.

As there is no available power within several miles, it became necessary for the railroad company to install its own plant at the bridge site, of sufficient capacity for the economical handling of the bridge at all times and with adequate provision for the handling of another bridge should four tracks be installed. In order to reduce the size of the plant and have power available at all times, a storage-battery installation was decided upon, with a maximum output of 640 amp-hr. The battery tanks were made larger than necessary to accommodate the present installation of plates, in order to provide for increased demands in the future.

The power house itself is located beside the right-of-way, 300 ft. distant from the bridge, and is of fireproof construction. The engine-room floor is on the same level with the tracks, which are elevated at this point, thus allowing ample basement room. The building is divided into two distinct parts, with separate entrances, the battery plant being installed in one section and the charging apparatus in the other.

The battery installation consists of two parts, the smaller one comprising sixty type E-7 cells, in glass jars, giving a total discharge of 120 amp-hr., which is employed for signaling, lighting the building and for operating all auxiliary circuits. The larger battery consists of 120 type F-11 cells, in lead-lined tanks, with an ultimate capacity of seventeen plates per cell. Each tank is provided with oil insulators to reduce grounding or leakage to a minimum. The large battery has a tap between cells Nos. 60 and 61, which is carried to the switchboard, and either half of the battery may be used for 120-volt service while the smaller battery is being charged. The switching arrangements provide for supplying 110-volt service on the signal circuit at all times.

A failure of the energy supply will set all signals at "danger," and to guard against this the introduction of the smaller battery was decided upon. The batteries were furnished by the Electric Storage Battery Company, the Manchester type of plate being used throughout. The present installation is capable of raising and lowering the bridge twenty times on a single charge. The normal charging rate of the larger battery is 55 amp, and under present conditions the installation is charged twice a week for periods of six to eight hours.

The charging apparatus consists of two 30-hp direct-connected, gasoline-engine generating sets for the larger battery and a 5-hp set for the smaller battery. Cooling water for the engines is obtained from a cistern sunk below the level of the river. The water filters through gravel to the cistern and is then raised by a motor-driven house pump to a roof tank over the power house. Each of the 30-hp engines is equipped with its own circulating pump. A gasoline storage tank of 1000 gal. capacity is installed a short distance away, providing an ample supply of fuel. A supply of compressed air, for starting the engines and operating certain auxiliaries, is furnished by a motor-driven compressor having a capacity of 15 cu. ft. per minute, with

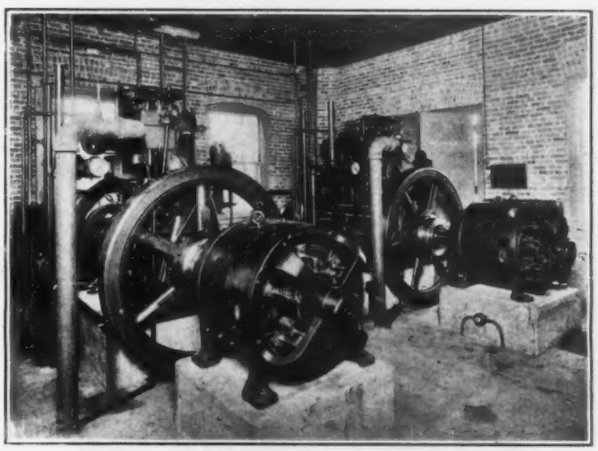


Fig. 1—Engine Room of Power House.

storage tanks in the basement having 100 cu. ft. capacity. The compressed air is piped from this point to each engine and to the bridge. The entire building, including battery room and basement, is heated by a hot-water heater which maintains a temperature of 60 deg. Fahr., even in the coldest weather.

The energy is conveyed from the power-house switch-

board to the operator's house in underground lead-covered cable. The lift span is operated by two main motors of 65 hp each and an auxiliary motor of 25 hp. The two main motors are under series-parallel control, which has proved to be both economical and reliable in connection with storage-battery supply, as the heavy starting torque required to raise the bridge off its seat is obtained with the

Fig. 2—The Bascule Bridge Over the Calumet River, Near South Chicago, Ill.

motors in series. The interval of lifting varies from one to one and a third minutes with the large motors and is twenty minutes with the smaller. The starting current under normal conditions is about 385 amp at 220 volts, diminishing as the speed increases. The current again rises to 400 amp when the motors are connected in parallel, falling to a steady value of 300 amp until the span meets the automatic stop and the brakes are applied. When one of the large motors alone is employed to raise the span, under conditions

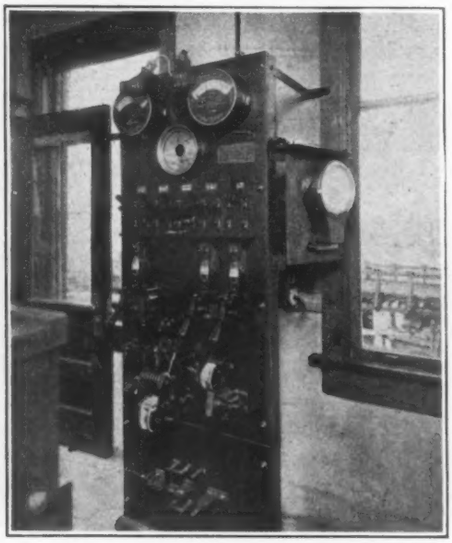


Fig. 3—Operator's House Switchboard.

which are otherwise unchanged, the starting current is about 500 amp.

Each of the 65-hp motors and the 4-hp lock motor are equipped with solenoid brakes, with an additional brake, operated by compressed air, on the first shaft of the speed-reduction gearing. As this was one of the first bridge installations employing air brakes, the results were awaited with considerable interest. On actual test it was found that the brakes would hold the bridge securely in any position under the most severe conditions that could possibly be encountered.

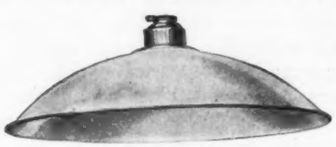
All motor controls in this installation are electrically interlocked, thereby preventing the operator from performing any operation out of its proper sequence. The motors for raising the span can receive no energy until the lock motor has first withdrawn the lock and come to rest, and, vice versa, the lock motor is inoperative until the lifting motors have come to rest and the bridge is seated. The last operation is further safeguarded by means of a contact switch on the end of the bridge, which closes the circuit of the lock motor only when the bridge is within an inch of seating. The current to the lifting motors is automatically cut off when the span has risen to a predetermined point in its travel, making it impossible for the operator to raise the span higher. Upon reversal of the controller handle, however, the lifting motors are energized in reverse rotation and the bridge is lowered. No automatic stops were installed to protect the span on its return travel, and the closing of the bridge is trusted entirely to the care and judgment of the operator.

The electrical control of the bridge is interlocked with the railroad company's signal system in such a way that it is impossible to energize any of the motors until the proper danger signals have been set and the master lever of the signal interlocking stand has been withdrawn. The last movement closes the main supply circuit to the motor starters, and the first operation of the bridge control locks the master lever, which prevents resetting the signals to "clear" while the span is unlocked.

The entire installation was made under the supervision of Mr. M. K. Trumbull, principal assistant engineer Chicago & Western Indiana Railroad Company, assisted by Mr. N. H. Jacobson. The signal interlocking equipment was installed under the supervision of Mr. F. E. Jacobs, signal engineer for the railroad company. The complete electrical equipment, including the design of the power plant, was furnished by Mr. C. H. Norwood, contracting electrical and mechanical engineer, Chicago, Ill.

INDUSTRIAL DOME REFLECTORS.

The latest type of metal reflector developed by the Nelite Works of the General Electric Company is a very shallow form of porcelain enameled-steel reflector, designed for service where the so-called flat types have heretofore been employed. The reflector has been designed with the object of minimizing glare effect and obtaining a desirable distribution of the light. The reflector is particularly adapted to service in rooms with low ceilings or where the total area to be lighted is large in comparison with the distance between units. It is said that heavier steel is now being used in the construction of all the smaller sizes of Holophane-D'Olier metal reflectors, a method of galvanizing has



Dome Reflector.

been perfected whereby the bodies of aluminized reflectors are rendered impervious to moisture and fumes, and an oxyacetylene process of welding the holders to the reflector bodies is now employed, which makes the finished units as solid as a single piece of metal. The developments here noted have been carried on under the direction of Mr. Henry Dolier, Jr.

DIFFERENTIAL-PRESSURE-RECORDING GAGE.

For recording the difference between two fluid pressures the Industrial Instrument Company, Foxboro, Mass., has developed a gage which differs from the ordinary pressure gage in that one pressure, instead of being atmospheric, is the minor one of the two fluid pressures. The moving element consists of a special pressure tube movement. For ranges below 10 lb. per square inch the diaphragm tube shown in Fig. 2 is employed, and for differential pressure exceeding 10 lb. per square inch the helical tube movement shown in Fig. 3 is used. In both it will be noticed that the pen arm is directly attached to a shaft giving a substantial support and rigidity to the movement.

Fig. 1—Differential Recording Gage.

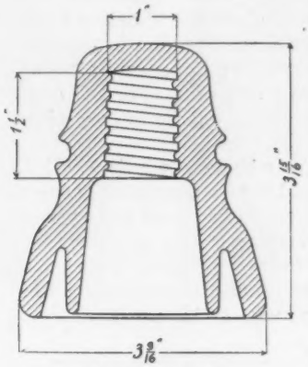
The instrument can be used to record the flow of fluids by means of Venturi or Pitot tubes. Another interesting and useful application is for recording the height of water in a boiler. Applied to the water column, the recorder gives a record not only of the height of water but of the time the water column or gage glass is blown, the time and amount the boiler is blown off and any other disturbance affecting the height of water in the gage glass, all of which information is now generally required as a part of the engineer's records. The continuous record will induce uniform condition of water level and be an efficient check against unsafe high or low water, thus insuring greater economy and safety. Disputes frequently arise when there is any trouble with water in cylinders. This recorder will show whether trouble is due to high water or must be looked for elsewhere. The recorder may be placed at a distance from the boiler and in case of boiler explosion will place responsibility where it belongs.

Fig. 2—Diaphragm Tube.

Fig. 3—Helical Tube.

LOW-VOLTAGE GLASS INSULATOR.

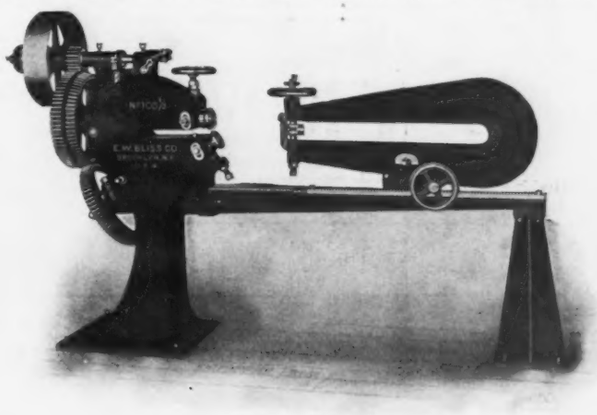
In the accompanying illustration are shown the cross-sectional dimensions of the glass insulator that has been developed as a result of many years of experience by both the American Telephone & Telegraph Company and the Western Union Telegraph Company. It provides the required surface to minimize leakage and the required strength to withstand mechanical strains. It has been developed by the Brookfield Glass Company, New York, which is said to have sold the first screw-thread glass insulator to the Western Union Telegraph Company in 1865.



Glass Insulator.

SHEARS FOR CIRCLE CUTTING.

Many makers of generators and motors require armature-core disks of various sizes, but not in sufficient quantity to justify the purchase of cutting dies for plain rings and presses large enough to operate the larger sizes. In the accompanying illustration is shown a circle shear built by the E. W. Bliss Company, of Brooklyn, N. Y., for cutting both the inside and outside of the plain rings, the angular position of the lower cutter giving as clear a cut on the inside as on the outside. In connection with an automatic notching press, it enables a manufacturer to make various sizes of armature disks with comparatively little outlay. It is also useful for any other work in which it is required to make circular rings or disks of sheet metal.



Shears for Circle Cutting.

The chief difference between the machines and the regular circle shear is in the form and arrangement of the shear blades. Instead of the cutter shafts being parallel, as usual,

they are inclined to each other in a manner which allows the lower and upper cutters to clear the cut surface of the ring without producing a burr. The clamp plates are attached to a deep arm, which is adjusted on the supporting arm according to the size cut to be taken.

The cutting of the outside of the ring is a true shearing operation, the blades being set to lap over one another in the usual way, and the cut is made in one revolution of the work. For this operation the center of the clamping plates must be offset from the line of the blade shafts, to the left of the shear blade center, to a point in line with that where the shearing begins. With the inside circle, however, the cutters are opened by the hand-wheel shown on the top of the machine to allow the sheet to be inserted, and the top cutter is then forced against but not through the sheet. The shear is started and the upper cutter is then forced down until the ring drops off. For this operation the center of the clamping plate must be in line with the shear-blade center.

The lower shear-blade shaft is carried in a swiveled sleeve and is capable of adjustment by the set screw shown. The purpose of the adjustment is to permit the setting of cutters after grinding. The grinding is done upon the faces of the cutters, which, of course, opens a clearance space between them, and the swiveling of the lower shaft enables this clearance to be closed up.

PARALLEL-FLOW STEAM TURBINE.

A type of steam turbine with vanes and blades producing parallel flow in the direction of the turbine shaft is being marketed by the Kerr Turbine Company, of Wellsville, N. Y., in place of the Kerr type with nozzle and double-cupped buckets heretofore manufactured by that firm.

The newer type, to be known as the "Economy" steam turbine, is built for condensing and non-condensing service in sizes of from 2 hp to 750 hp and in sizes up to 450 hp for exhaust steam. A decrease of steam consumption is claimed by the manufacturer for the "Economy" over the former type. This is illustrated by the accompanying curves indicating performances under identical conditions of an old-type machine rated at 250 bhp and an "Economy" type turbine having the same number and diameter of wheels. With both turbines taking steam at 100 lb., the water rate under 26 in. vacuum was 24 lb. for the old as compared to 18.7 lb. for the new construction.

The departure from former design has been accompanied not only by a decrease in size, but by an increase in strength of all the working parts. Each set of nozzles discharges onto a separate bucket wheel. One set of nozzles and one wheel constitute a stage. The cylinder of the turbine is divided into separate stages by separate circular diaphragm castings. Each diaphragm casting contains one set of nozzles, provides for one bucket wheel and is arched at the center to withstand steam pressure to best advantage. These diaphragm castings are accurately centered with each other and with the two end castings by turned and bored tongue and grooved joints, the weight of the turbine being carried by feet on the end castings. The bearing cases also are centered by accurately machined faces on the end castings and fall into alignment the same as the diaphragms.

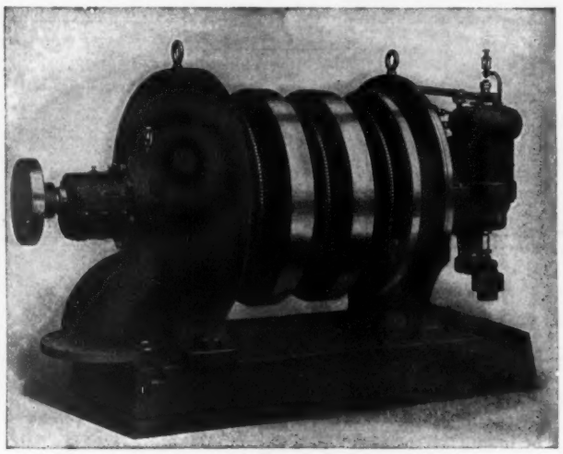


Fig. 2—Economy Turbine with Casing Removed.

Leakage of steam at the shaft at steam and exhaust end and between stages is prevented by floating bronze bushings in contact with ground metal seats and held to place on the shaft by the difference in steam pressures in the stages. In addition to these bushings there are packing glands for soft ring packing, between which and the metal glands is a chamber which receives the leakage from the metal glands.

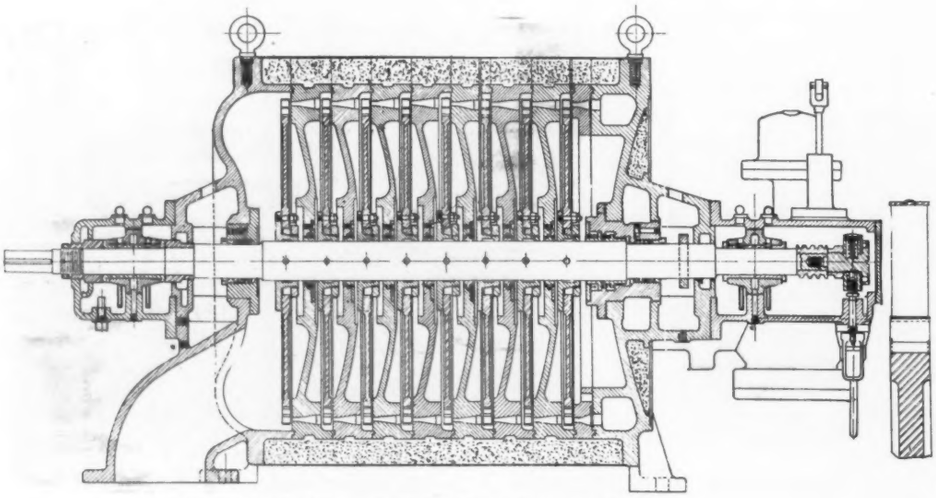


Fig. 1—Section Through Eight-Stage Economy Turbine.

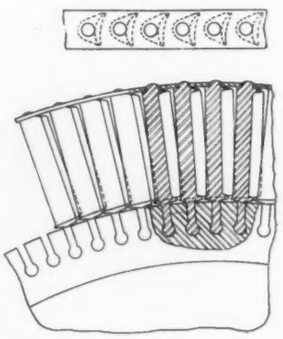


Fig. 3—Section of Bucket Wheel.

The nozzles are located adjacent to the bucket wheels with axial clearance between them and the buckets. The rotor is made up of machined flange-steel bucket wheels, mounted upon the shaft. Each bucket wheel is bolted to a three-piece split-steel or iron hub which is fitted to the shaft and kept from endwise or rotary movement by pin

keys. A split mitered ring is forced by a lock nut into the bore of the disk and against a turned taper. The buckets are of drop forged steel dovetailed and riveted into the drilled and s'otted openings of the wheels.

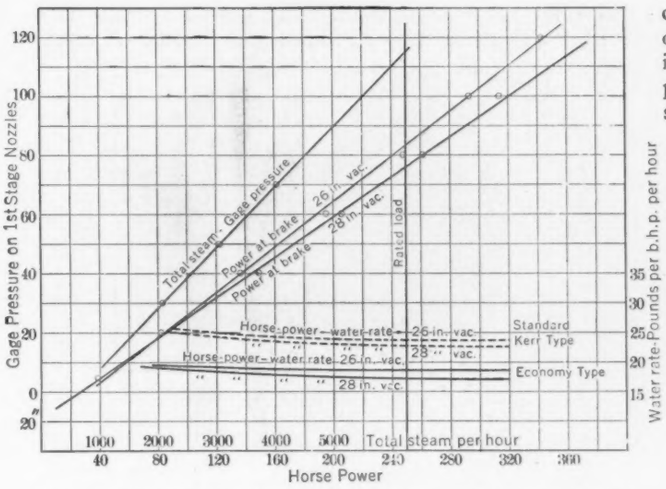

Gage Pressure on 1st Stage Nozzles
Water rate-Pounds per b.h.p. per hour
Total steam: Gage pressure
Power at brake 26 in. vac.
Power at brake 28 in. vac.
Rated load
Horse-power—water-rate—26 in. vac.
Standard Kerr Type
28 " vac.
Horse-power—water-rate 26 in. vac.
Economy Type
28 in. vac.
1000 2000 3000 4000 5000 Total steam per hour
40 80 120 160 200 240 280 320 360
Horse Power

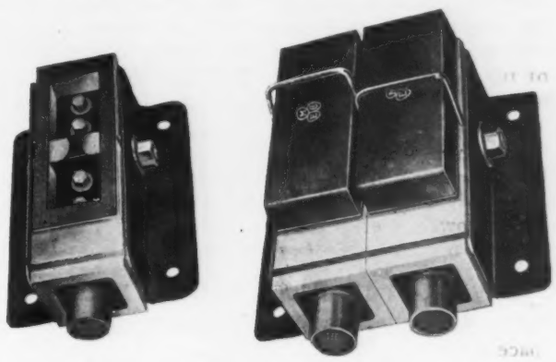
Fig. 3—Performance Curves of Old-Type and Economy-Type Turbines.

Steam is admitted to the turbine through a steam chest provided with ports to the first stage nozzles and with a double poppet valve operated by the governor. The governing mechanism is of two constructions, the construction for average service consisting of semi-annular weights mounted directly upon the turbine shaft and acting through lever connections to throttle the steam valve. On the larger sizes of units, especially those for driving generators where close regulation is desired, the governor consists of spherical weights driven through a spiral gear on the turbine shaft and acting upon the valve steam through a relay pilot valve. An emergency governor is also employed to close a valve in the steam line when for any reason the turbine overspeeds.

The main bearings are ring-oiling, self-aligning and split in halves for removal from the bearing case by removing the bearing-case cap. On high-speed machines oil is forced into the bearings at about 3-lb. pressure by a rotary pump on the end of the governor spindle from the reservoir that supplies the governor. A suitable thrust bearing and locating collar are provided in connection with the exhaust end bearing, which insure correct position of the bucket wheels with reference to the nozzles and maintain the alignment.

PORCELAIN SUBWAY CUT-OUT AND BRANCH PLUG.

The Metropolitan Engineering Company, of Brooklyn, N. Y., is making a porcelain subway cut-out and branch plug which possesses features of merit for low-tension two-wire and three-wire underground systems, especially where it is necessary to take off several branch circuits, in that it does not entail splicing cables, wiping joints, etc. The device consists of a sectional subway unit with which any number of other units can be connected so as to make as large a junction box as is desirable. It is also applicable for making ordinary cable joints in subway plugs, acting not only as a joint but as an insulator where it is desired to avoid electrolytic action on subway cables. The insulator can be placed on the cable without cutting the cable itself, and in a very short space of time. Lead floss is calked in the annular space around the cable, making the joint virtually a part of the lead sheath, so that if the cable were entirely disconnected from the section the lead would remain a solid mass attached to the cable itself. Each sectional unit has a maximum current-carrying capacity of 1200 amp. In underground work where large junction boxes carrying upward of 1000 amp are used on alternating-current circuits it is necessary for them to be made of some metal other than iron, brass or aluminum, in order to avoid heating effects, and, inasmuch as the cut-outs shown are made of porcelain, induction effects are not encountered. In the construction of manhole distribution boxes the size of the unit



Subway Cut-Outs and Branch Plugs.

is also a very great factor. The Murray unit requires only 40 per cent of the space called for by standard construction.

ELECTRICITY AT FENWAY PARK BALL GROUNDS, BOSTON.

The new grounds and reinforced-concrete grand stand of the Boston American League Baseball Club at Fenway Park, Boston, are equipped with extensive facilities for scoring the plays of the national game by electricity and for transmitting the story of the diamond by telegraph to other parts of the city and country. Behind the left fielder's territory and opposite the grand stand and pavilion a large score-board is operated electrically from a signaling desk in the press box, located in the center of the main stand and at the highest point in the structure. Every ball,

Signaling Apparatus for Ball Ground.

strike, out and batter number are registered on the score-board by the simple act of pressing a push-button in the desk set, which contains twenty-three keys, twenty-three signaling buttons, an operator's telephone set and a generator circuit. The indicators in the field score-board are actuated by electromagnets, fourteen dry cells normally

being used in the transmitting circuits. A telephone is also provided at the score-board itself for use in setting up the scores of innings.

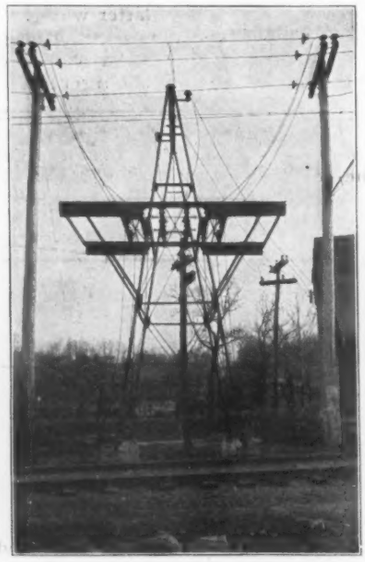
The press box also contains a plug switchboard and circuits for sixteen telegraph instruments, including wires for the Associated Press, local press and foreign service. The features of the game are recounted by telegraph even for down-town papers, the contention being that greater speed and accuracy are obtained than with the telephone. Direct wires are in service between Boston and the home city of the visiting team at all games. Rubber-covered wires run in twisted pairs are used in the press-box service. Although the telephone is not used to any extent in newspaper reporting of the game, it is an important factor in the handling of extra baseball cars by the local street railway, and the premises are liberally supplied with pay stations. The signaling equipment above referred to was supplied by the Stromberg-Carlson Telephone Manufacturing Company and the World's Scoreboard & Advertising Company, Chicago.

33,000-VOLT DOUBLE-THROW, THREE-POLE WEATHERPROOF SWITCH.

In deciding upon the system of switching and controlling high-tension transmission systems the choice of disconnecting switches is governed by several conditions. If it is desired simply to provide means for disconnecting or isolating lines, the regular type of a simple pole-mounting, weatherproof disconnecting switch should be used, but when it is necessary to provide means for quickly and safely throwing a station over from one source of supply to another a different type must be employed.

For use on 33,000-volt, three-phase circuits a type of switch has been developed by the Delta-Star Electric Company, Chicago, Ill. The switch proper is supported on horizontal iron framework, in turn fastened to a specially designed tower between two of the transmission poles.

The switch is of the plunger type, having a set of three



Special Tower for 33,000-Volt Switch.

movable double-ended contacts so located as to engage three fixed bell-shaped contacts at either end of the framework to which the incoming lines are connected. The movable contacts are attached to line wires running to the station to be connected, and by means of a rack or pinion they can be thrown to either incoming line, all three phases being operated simultaneously.

COMMUTATING-POLE ROTARY CONVERTER.

Commutating poles as applied to rotary converters fulfil the same functions and result in the same advantages as in their more familiar application to direct-current generators and motors; they insure spark'ess commutation with a fixed brush position from no-load to heavy overloads. A rotary

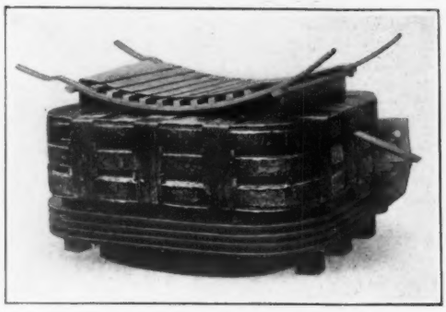


Fig. 1—Main Pole with Windings.

converter is inherently a better commutating machine than a direct-current generator, and less commutating field is required.

In the Westinghouse rotary converter the commutating-pole winding is of bar copper bent into the proper form. The inside turns are not insulated but are covered with a heat-proof black paint. The outside turns are insulated with tape which is impregnated with an insulating compound. The coil is supported by insulated bolts, and to prevent accidental grounding an insulating shell is placed between the commutating pole and its winding. The damper winding, which is separate for each pole, serves also as a starting winding, thus insuring stable operation in the same manner as does the squirrel-cage winding on a non-commutating-pole machine. Owing to inherent qualities in the commutating-pole rotary converter, it is necessary to raise the brushes from the commutator during the starting period when the machine is started as a self-accelerating alternating-current motor. The brushes are raised by a single throw-over lever.

Fig. 2 shows an illustration of a 1500-kw, 600-volt com-

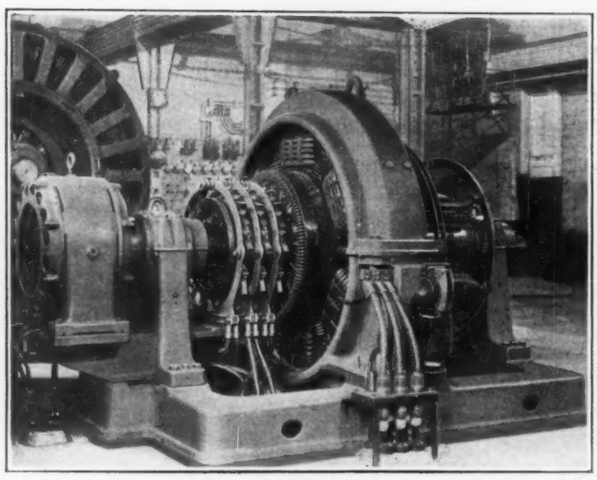


Fig. 2—Converter with Remote-Control Switch for Short-Circuiting the Commutating Winding at Starting.

mutating-pole motor-started converter in an industrial plant. A special feature of this application is the electrically operated remotely controlled switches mounted on the sides of the converter frame, which are operated by a small control switch located on the switchboard. These switches are used for short-circuiting the commutating winding at starting.

Industrial and Financial News

EXPANSION is now taking place in many lines, and in the present conditions reported in the majority of important branches of industry there are abundant signs that this period of commercial awakening will soon become general. Much of the optimism now found in business circles is a result of the excellent conditions in the agricultural districts. It is from these parts of the country that the most favorable advices of the week have been received. Railroad and banking officials who have been on the ground say that the outlook for "bumper" crops is decidedly bright, and that these prospects are already causing trade revival in the northwestern part of the country. In addition to these prospects for record yields, conditions in the metal markets are also full of promise. Prices continue to incline toward new high levels and demand is unchecked. Signs of progress are found in the report of the United States Steel Corporation for the quarter ended June 30, which showed total net earnings of $25,102,285, as compared with $17,826,973 in the preceding quarter. The money markets are showing more firmness than in recent weeks, and the general conditions indicate that preparations are being made for the crop financing due a little later on. Rates in New York July 31 were: Call, 2½@2¾ per cent; ninety days, 3¾@4 per cent.

Telluride Power Company Changes Hands.—J. R. Nutt, of Cleveland, on behalf of himself and New York and Boston associates, has purchased a controlling interest in the Telluride Power Company from the Cleveland interests which have been in control of the company for many years. A circular letter emanating from Cleveland, signed by officers and directors of the Telluride company, says: "We have sold to Mr. J. R. Nutt our entire holdings of stock and bonds, receiving for the stock 25 cents per share and for the bonds par and interest. Our stock has been paid for and our bonds are to be paid for on or before Oct. 1, 1912, with accrued interest to date of payment. Mr. Nutt has also agreed to buy at the same price any of the remaining stock and bonds that may be forwarded to the Citizens' Savings & Trust Company, Cleveland, on or before Sept. 1, paying for the stock by Sept. 1 and for the bonds on or before Oct. 1, 1912." The signers of this letter were: O. M. Stafford, Ralph T. King, George N. Chandler, A. T. Perry, D. Leuty, Andrew Squire and Parmely Herrick. Mr. Squire is president of the Telluride company. On Dec. 31, 1911, the company had outstanding $4,498,125 capital stock and $4,312,000 bonds. The Telluride system is of more than usual interest in view of the fact that it was the world's pioneer high-tension transmission system. Full details of the company, including its early history, its development and present engineering features, appeared in several articles in the *Electrical World* last year, beginning with the issue for Nov. 18, 1911.

General Vehicle Secures American Manufacturing Rights for Mercedes Commercial Cars.—Realizing that separate provinces exist in the commercial vehicle field for gasoline and electric trucks, the General Vehicle Company, which in the past has devoted its attention exclusively to the manufacturing and exploiting of electric vehicles, has arranged to expand its operations to include the manufacture of gasoline-propelled trucks by securing the American rights of the Mercedes gasoline truck manufactured by the Daimler Motoren Gesellschaft of Germany. President Wagoner of the General Vehicle Company stated in this connection: "We have succeeded in securing the right to import German-manufactured Mercedes commercial vehicles and the exclusive manufacturing rights for the same in the United States. The American-built Mercedes truck will be a replica of that of German manufacture, and will be manufactured from the original drawings of the Daimler Motoren Gesellschaft, which will also furnish material, tools, jigs and fixtures. Pending the completion of manufacturing arrangements we will import Mercedes trucks to supply the immediate demand. The electric truck and the gasoline truck have each its particular field. The General Vehicle Company is now prepared to cover the entire field of commercial-vehicle service. It will continue its past practice of recommending and selling the proper vehicles for each class of service."

Texas Power & Light Company Acquires More Properties.—Interests identified with the Texas Power & Light Company, which was recently formed by the Electric Bond & Share Company and has taken over a number of gas and electric properties in Texas, as was noted in these columns May 18 and June 8, have acquired the gas properties of the Brownwood Gas & Electric Company, of Brownwood, Tex. It is expected that these properties will be taken over by the Texas Power & Light Company and operated by that company in connection with its other properties. At the present time the Texas company is operating electric light and gas properties in Waco and Cleburne and electric-lighting properties in Hillsboro, Waxahachie, Temple, Sherman and Bonham, Tex. The company will build a large central station in Waco, as was previously stated in these columns. J. F. Stickland, former president of the American Railway & Lighting Company, has been elected president of the new Texas company.

Idaho Railway, Light & Power Stock Offer Expires.—The offer to exchange the common or preferred stock of the Idaho-Oregon Light & Power Company for an equal amount of the common or preferred stock of the Idaho Railway, Light & Power Company, share for share, at the office of Kissel, Kinnicut & Company, 14 Wall Street, New York, expired on Aug. 1. Details of the formation of the Idaho Railway, Light & Power Company, which is a merger of several electric railway, light and power companies operating in and near Boise, Idaho, were given in these columns June 22, 1912.

Successor for Sedalia Light & Traction Company.—The City Light & Traction Company, of Sedalia, Mo., has been incorporated under the laws of Missouri in the interest of H. L. Doherty & Company, with an authorized capital of $2,500,000, as successor to the Sedalia (Mo.) Light & Traction Company. The property of the latter was sold under foreclosure on June 7, 1912, and is now being managed by the Doherty company, as was stated in the *Electrical World* June 15, 1912.

Authorize Kentucky Telephone Merger.—The Kentucky State Railroad Commission has given its sanction to a consolidation of the Cumberland Telephone & Telegraph Company, the Hopkinsville Home Telephone Company, the Pembroke Home Telephone Company and the Todd County Home Telephone Company. These companies operate and maintain systems in Todd and Christian Counties and will be known as the Christian-Todd Telephone Company.

Brooklyn Rapid Transit Has Big Year.—The report of the Brooklyn Rapid Transit Company for the fiscal year ended June 30, 1912, issued this week, shows gross earnings of $23,226,551, which represents a gain of $1,240,007 over the 1910 total. The surplus for the year available for dividends was $3,731,259, which compares with $3,059,944 in the preceding year.

Active Trading in Westinghouse Common.—Recent briskness in the common stock of the Westinghouse Electric & Manufacturing Company is attributed in financial circles to reports that the management would place the stock on a 5 per cent dividend basis in September.

Annual Meeting of Canadian Light & Power Company.—The annual meeting of the Canadian Light & Power Company of Montreal will be held in Montreal on Aug. 6. An increase of the capital stock from $6,000,000 to $7,000,000 will be ratified at the meeting.

Ancillary Receivers for National Electric Signalling Company.—S. M. Kinter, of Pittsburgh, and H. M. Barrett, of Greenfield, N. J., have been appointed ancillary receivers of the National Electric Signalling Company, as a result of a bill filed by D. S. Walcott, a stockholder.

Affairs of Illinois Northern Utilities Company.—A recently issued bond circular gives some additional information about the newly organized Illinois Northern Utilities Company. This is one of the "Insull companies," Samuel Insull being its president. It was organized in April of this year under the laws of Illinois. It has acquired all the properties formerly belonging to fifteen operating companies in the northwestern portion of Illinois, some of the more important being the Belvidere Gas & Electric Company, Sterling Gas & Electric Light Company, Lee County Lighting Company, DeKalb County Gas Company, Oregon Power Company, Morrison Gas & Electric Company, Mendota Light & Heat Company and Plano Heat, Light & Power Company. The company serves forty-six communities with electrical energy, these towns having a combined population of nearly 60,000. Among them are Sterling, Dixon, Belvidere, Oregon, Mendota, Morrison and Fulton. The company also controls the street-railway systems of Sterling and Dixon and an interurban line connecting these two cities. The territory served by the company adjoins on the west the territory served by the Public Service Company of Northern Illinois. These two companies are operated under practically the same management. The officers of the company, in addition to Mr. Insull, are John F. Gilchrist, assistant to the president; Frank J. Baker and Charles A. Munroe, vice-presidents, and John H. Gulick, secretary and treasurer. These, with Frederick Sargent, William A. Fox, Louis A. Ferguson and Edward P. Russell, constitute the board of directors. The capitalization on May 11, 1912, was as follows: Outstanding common stock, $4,635,000; outstanding 6 per cent preferred stock, $1,808,000; outstanding 5 per cent bonds, $1,632,000; underlying bonds on portion of property, $818,000. The earnings of the properties for the year ended Dec. 31, 1911, were $532,037 gross and $215,426 net. On the date mentioned the company had on hand $750,000 in cash to be used for extensions and improvements.

Great Shoshone & Twin Falls (Idaho) Water Power Returns.—The earnings statement of the Great Shoshone & Twin Falls Water Power Company for the first half of 1912, just announced, shows that the gross earnings for the first half of 1912 were $80,426, with operating expenses $34,798 and net earnings $45,628. The company officers esitmate that, upon this showing and the fact that many large contracts for service will become operative during the latter half of this year, the gross earnings for 1912 will be at least $180,000, with operating expenses and taxes about $65,000, which would give net earnings of $115,000, equal to one and two-thirds times the interest requirements of the funded debt at this time. The Great Shoshone & Twin Falls Water Power Company controls a number of hydroelectric power sites on the Snake River in Southern Idaho, which when developed will have an ultimate capacity of 92,000 hp. The company now has two of its generating plants in operation and is pushing development work at the remaining sites. The territory served lies in the rapidly growing irrigated agricultural section of southern Idaho. The high-tension transmission lines are about 250 miles in length and reach eighteen towns. The company is owned and controlled by the American Water Works & Guarantee Company, of Pittsburgh, Pa. J. S. & W. S. Kuhn, Inc., of Pittsburgh, are offering a limited amount of the company's 6 per cent notes, due Nov. 1, 1920, and Nov. 1, 1925. The West Penn Traction & Water Power Company, also controlled by the American Water Works & Guarantee Company, took over the property of the Wheeling (W. Va.) Traction Company on Aug. 1. Surveys are now being made for the construction of a high-tension transmission line, connecting the system of the Wheeling company with that of the West Penn company through Washington, Pa.

Automatic Telephone Manufacturing Interests.—Financial interests represented by Ogden Armour, of Chicago, the Harriman estate and James Stillman, of New York, have secured an option on 51 per cent of the $4,609,200 outstanding capital stock of the Automatic Electric Company, of Chicago. This company is the principal manufacturer of automatic telephone apparatus as used by the independent companies. It is said that it will adopt an aggressive attitude in opposition to the Bell companies. It is further stated that the option runs for five years from July, 1912, and that at any time within that period the stock may be purchased at $150 a share. During the life of the option the management of the Automatic Electric Company shall be undisturbed, with the proviso that stockholders may not vote any increase in the capital stock. The company's stock was quoted at $68 per share on July 22. All stockholders are entitled to put their stock in at $150. Earnings of the company for the last fiscal year are reported as follows: Gross, $911,446; operating expenses, interest and taxes, $373,186; net, $538,260; depreciation, $200,000, and surplus for year, $338,250. These earnings are equal to 7.33 per cent on the outstanding capital stock. The company's total surplus is said to be $924,496. Prior to taking over the Strowger automatic telephone patents, when it did a purely manufacturing business, the company paid 8 per cent. In February, 1908, however, dividends were discontinued and not resumed until March, 1912, when they were begun at the rate of 4 per cent. The Chicago Utilities Company has succeeded the Chicago Subway Company as the underlying owner of the tunnels, narrow-gage electric freight railways and automatic telephone system of the Illinois Tunnel Company of Chicago.

United Light & Railways Company Enlarging.—As recently announced, the United Light & Railways Company has enlarged the scope of its operations. It operates public-utility companies in the States of Illinois, Indiana, Iowa, Michigan and Tennessee, its electric-service properties being in Fort Dodge, Ia.; Muscatine, Ia.; Laporte, Ind.; Davenport, Ia.; Rock Island, Ill., and Moline, Ill. The outstanding capitalization includes $8,000,000 in first and second preferred stock, $5,287,500 in common stock, $4,375,000 in bonds, and a one-year note for $750,000, due June 10, 1913. The recently enlarged board of directors is comprised of Glenn M. Averill, Cedar Rapids, Ia.; William Butterworth, Moline, Ill.; George B. Caldwell, Chicago; E. Golden Filer, Manistee, Mich.; Claude Hamilton, Grand Rapids, Mich.; Frank T. Hulswit, Grand Rapids, Mich.; Samuel Insull, Chicago; J. F. Porter, Davenport, Ia.; Benjamin C. Robinson, Grand Rapids, Mich.; Edward P. Russell, Chicago; Richard Schaddelee, Grand Rapids, Mich.; Francis E. Smith, Boston; H. L. Stuart, Chicago; Richard H. Swartwout, New York; J. G. White, New York. The headquarters of the company are now in Grand Rapids, but will probably be removed to Chicago before long.

City of Louisville (Ky.) to Sell Its Lighting Company Shares.—Through an agreement reached between Mayor W. O. Head, of Louisville, and J. B. Brown, who with W. H. Harries represents the H. M. Byllesby Company, Chicago, the city of Louisville will sell to the Byllesby interests the 9250 shares of stock which it owns in the Louisvills Gas Company. The latter controls the Louisville Lighting Company, which is one of the companies to be included in the merger of public utility concerns in and near Louisville toward which negotiations have been in progress for some time, as previously noted in these columns. The Mayor has called upon the Louisville General Council to legalize the sale of this stock, which is to be made at $150 per share, and to give authority to the gas company to annul a provision of its charter which prohibits any individual from acquiring more than 1000 shares of the company's stock. A movement to determine a basis upon which the Louisville Lighting Company may make an offer to the Louisville Railway Company, the local traction company, for supplying it with electric energy is now under way.

To Redeem Stockton (Cal.) Gas & Electric Bonds.—Notice has been given that all of the outstanding bonds of the Stockton Gas & Electric Corporation, which were assumed by the Western States Gas & Electric Company when the latter was formed as a consolidation of the Stockton company and a number of other public utility companies in California, have been called for redemption on Jan. 1, 1914, at the office of the Mercantile Trust Company of San Francisco at their face value and a premium of 6 per cent. together with all interest accrued and unpaid on the date mentioned, upon which interest will cease. Any of these bonds will be paid before Jan. 1, 1914, if presented at the office of the trust company, at their face value, together with the 6 per cent premium and interest to date of payment.

Stromberg-Carlson Telephone Company's Plans.—Stockholders of the Stromberg-Carlson Telephone Manufacturing Company held a special meeting in Rochester, N. Y., on July 29, to vote upon a proposition to dissolve the company in acordance with plans to which reference was made in these columns July 6. This statement was given out: "At a meeting of stockholders of the Stromberg-Carlson Telephone Manufacturing Company, at which over 23,000 shares were represented, all voted in favor of liquidating the corporation. The directors will meet in a day or two and in all probability will declare a cash dividend of $38.58 per share, of which $28.58 per share is to pay dividends in full on the preferred stock and $10 per share is toward the liquidation of the par value of the preferred stocks. The reason for this step is not that the company is in any financial difficulties. It owes no indebtedness of any sort and has a large amount of cash on hand. The sole reason is that it has too large a plant and too much capital invested for the volume of business to be obtained. Announcement was made in the meeting that a plan was being formulated looking to the organization of a new and smaller company to take over portions of the plant, machinery, merchandise, etc., and continue the business of the present company. Details of this plan will be announced as soon as they can be perfected." The company was incorporated in 1902 with a capital of $3,000,000. Its net profits in 1911 were $10,207, as was noted in these columns March 2, 1912.

American Railway & Lighting (Tex.) Bonds Called.—All of the issue of $500,000 5 per cent. collateral trust sinking fund bonds of the American Railway & Lighting Company have been called for payment at 103 and interest at the office of the Equitable Trust Company, on Sept. 1, 1912. These bonds were issued March 1, 1907, and the sinking fund of $5,000 a year became operative on March 1, 1912. This company formerly controlled the gas and electric plants in and around Waco, Tex., that have been taken over by the Texas Light & Power Company, which was recently organized by the Electric Bond & Share Company as noted on page 279 of this issue.

Georgia-Carolina Power Subscriptions.—Warrants for subscriptions to the new bonds and preferred stock of the Georgia-Carolina Power Company, which was recently organized for the purpose of building a hydroelectric plant in connection with the Augusta-Aiken Railway & Electric Corporation, as was noted in these columns last week, have been issued. Each holder of fifteen shares of Augusta-Aiken common and preferred stocks is entitled to subscribe to one $1,000 5 per cent bond and $300 par value 7 per cent preferred stock of the Georgia-Carolina company at 88. The right to subscribe expires on Aug. 15.

Pennsylvania Light & Power Company, of Pittsburgh, Sold.—The Allegheny County Light Company, a subsidiary of the Philadelphia Company, has secured 10,000 of the 17,000 shares of the Pennsylvania Light & Power Company's outstanding stock. The Pennsylvania company formerly operated entirely in the North Side of Pittsburgh, but recently received a franchise which authorized it to operate in other parts of the city. The Allegheny company recently acquired the Phipps Power Company, which operated in the downtown part of Pittsburgh, as was stated in these columns June 1, 1912.

REPORTS OF EARNINGS

VIRGINIA RAILWAY & POWER COMPANY.

The reports of the Virginia Railway & Power Company for June, and for the twelve months ended June 30, 1912 and 1911, compare as follows:

June:	1912.	1911.
Gross	$386,621	$375,205
Net	178,780	156,451
Other income	6,349	16,108
Total income	$185,129	$172,559
Surplus after charges	64,532	55,750
Twelve months, June 30:	**1912.**	**1911.**
Gross	$4,558,194	$4,336,206
Net	2,135,290	1,994,530
Other income	69,158	49,296
Total income	$2,204,449	$2,040,826
Surplus after charges	781,247	643,882

NEW ORLEANS RAILWAY & LIGHT COMPANY.

The income statements of the New Orleans Railway & Light Company for the six months ended June 30, 1912 and 1911, compare as follows:

Six months:	1912.	1911.
Gross earnings	$3,342,493	$3,195,053
Net after taxes	1,354,137	1,232,915
Surplus after charges	531,456	426,450

ONTARIO POWER COMPANY, NIAGARA FALLS.

The reports of the Ontario Power Company, of Niagara Falls, and the Ontario Transmission Company, Ltd., for the six months ended June 30, 1912 and 1911, are as follows:

Six months:	1912.	1911.
Gross earnings	$538,772	$408,974
Net earnings	451,104	336,311
Other income	11,205	8,060
Total income	$462,309	$344,371
Interest charges	323,793	292,638
Surplus	138,516	51,732

STANDARD GAS & ELECTRIC COMPANY, CHICAGO.

The Standard Gas & Electric Company, which is the holding company for securities of a number of properties managed by H. M. Byllesby & Company, reports earnings for the twelve months ended June 30, 1912, as follows:

Gross earnings	$1,919,052
Expenses	37,698
Net earnings	$1,881,353
Interest charges	469,557
Available for dividends	$1,411,795
Preferred stock dividends	684,894
Surplus	$726,900

The balance sheet as of June 30, 1912, shows: Assets—Securities owned, $30,940,236; cash, interest and dividends receivable, $710,791; organization expenses, $46,094; premium on bonds and coupon notes redeemed, $168,500; other sundry assets, $8,845; total assets, $31,874,467. Liabilities—Bonds, $10,300,000; preferred stock, $10,977,950; common stock, $9,343,150; interest and dividends accrued, $124,686; notes and accounts payable, $119,905; surplus, $1,008,776; total liabilities, $31,874,467.

PRICES IN THE NEW YORK METAL MARKET

Copper:	July 23 Bid.	July 23 Asked.	July 30 Bid.	July 30 Asked.
Standard:				
Spot	17.25	17.50	17.00	17.50
July	17.25	17.50	17.00	17.50
August	17.30	17.55	17.00	17.50
September	17.30	17.60	17.00	17.50
October	17.30	17.60	17.00	17.50
London quotation:	£ s d		£ s d	
Standard copper, spot	79 0 0		77 10 0	
Standard copper, futures	78 17 6		77 10 0	
Prime Lake	17.50		17.50 to 17.60	
Electrolytic	17.50		17.50 to 17.60	
Casting	17.40		17.25 to 17.30	
Lead	4.75		4.75	
Sheet zinc, f.o.b. smelter	8.75		8.75	
Spelter, spot	7.25		7.25	
Nickel	40.00 to 41.00		40.00 to 41.00	
Aluminum:				
No. 1 pure ingot	21½ to 22½		21½ to 22½	
Rods and wire, base	32		32	
Sheets, base	33½		33½	
OLD METALS.				
Heavy copper and wire	15.50		15.50	
Brass, heavy	10.00		10.00	
Brass, light	8.00		7.75	
Lead, heavy	4.40		4.40	
Zinc, scrap	5.75		5.65	

COPPER EXPORTS IN JULY

Total tons, including	July 23, 20,680	July 30, 24,652

STOCK MARKET PRICES

	July 24.	July 31.
Allis-Chalmers	1⅛*	1⅛*
Allis-Chalmers, pf.	4½	4½*
Amalgamated Copper	82¾	83⅛
Amer. Tel. & Tel.	145⅝	145⅞
Boston Edison	297	297
Commonwealth Edison	140	139
Electric Storage Battery	54¾	55
General Electric	186	182
Mackay Companies	92¼*	92¼*
Mackay Companies, pf.	69⅜	69¾*
Philadelphia Electric	21⅝	22¼
Western Union	82¾	81¾
Westinghouse	80¾	80
Westinghouse, pf.	121	121*

*Last price quoted.

Personal

Mr. James T. Whittlesey, chief engineer of the Public Service Electric Company, Newark, N. J., has resigned to take up his residence in California.

Mr. H. J. Gille has severed his connection with the Minneapolis General Electric Company to become associated with the St. Paul Gaslight Company, St. Paul, Minn.

Mr. R. L. Brunet, industrial engineer of the Public Service Electric Company, Newark, N. J., has been appointed electrical and gas engineer of the Department of Public Works, Providence, R. I.

Mr. Andrew J. Kelly has been appointed superintendent of the Newark (N. J.) power plant of the Public Service Electric Company, succeeding Mr. F. W. Casler, now general superintendent of plants.

Mr. T. P. Pinckard, who recently resigned as contract agent for the Peoria (Ill.) Gas & Electric Company, has removed to Detroit to engage in central-station work for a syndicate having headquarters in that city.

Mr. Norman G. Kenan, president of the Union Gas & Electric Company, Cincinnati, Ohio, has completely recovered from his recent operation for appendicitis and is now busily engaged in his work at the Union office.

Mr. T. C. Roberts, general superintendent and chief engineer of the Arkansas Valley Railway, Light & Power Company, has resigned to accept the position of chief engineer of the United Verde Copper Company, Jerome, Ariz.

Mr. B. E. Parker, formerly superintendent of transportation of the Rockford & Interurban Railway Company, of Rockford, Ill., has been appointed general superintendent of the Evansville Public Service Company, Evansville, Ind.

Mr. L. E. Holderman, manager of the Coshocton Light & Heating Company, of Coshocton, Ohio, has resigned as a result of the merger by which the property of the company has been taken over by the United Service Company, of Scranton, Pa.

Mr. W. P. Moran, who for the past five years has been connected with the Mohawk (N. Y.) Gas Company, has recently been appointed manager of the Empire Gas & Electric Company, Auburn, N. Y. Mr. Moran has been succeeded by Mr. J. A. Daniels.

Mr. Robert H. Parker, manager of the Salt Lake City office of the General Electric Company, has been appointed manager of the New Haven (Conn.) office, succeeding Mr. L. H. Lewis, who comes to New York to be assistant manager of the supply department.

Mr. J. D. Beebe has resigned his position as manager of the office of the Pacific Power & Light Company at Prosser, Wash., to become construction engineer for the Arizona Copper Company at Clifton, Ariz. His successor at Prosser will be Mr. W. E. Gay, of North Yakima, Wash.

Mr. Lemuel S. Boggs has resigned his position as superintendent of electrical construction of the New York, New Haven & Hartford Railroad to become general manager of the Macon (Ga.) Railway & Light Company. Mr. Boggs was formerly associated with the Westinghouse Electric & Manufacturing Company.

Mr. S. Morgan Bushnell, manager of the Illinois Maintenance Company, of Chicago, was married on July 24 to Miss Edyth Alice Decker, of Edgewater. A bachelor dinner was given on July 19 in honor of Mr. Bushnell at the Chicago Athletic Club by fifteen of the "old guard" of the former Chicago Edison Company. Mr. and Mrs. Bushnell are spending their honeymoon in Europe.

Mr. J. McLean Kingsbury has resigned his position as engineer-in-charge of the switchboard department of the Allis-Chalmers Company, to give his personal attention to the manufacture and sale of the "Auto-Vac," an accessory which has recently been placed on the market by the Auto Vacuum Cleaner Company of Milwaukee, in which company he has a large interest.

Mr. Frederic P. Vose, of Chicago, was elected president of the Commercial Law League of America, in Denver, on July 25. Mr. Vose, who is a lawyer, is affiliated so closely with electrical interests that the electrical men of Chicago regard him as one of their own. He is secretary and treasurer of the National Electric Credit Association, in which he has been active since the organization of the association in 1898. He is also secretary-treasurer of the Electrical Credit Association of Chicago, statesman-at-large of the Sons of Jove and former president of the Electric Club of Chicago.

Mr. Alfred Still has been appointed chief electrical engineer to the mining department of the Algoma Steel Corporation, with headquarters at Magpie Mine, Ontario. This corporation is under the control of the Lake Superior Power Company of Sault Ste. Marie, Ontario. Apart from complete electric power equipments at both the Helen and Magpie mines, a hydroelectric station now nearing completion will supply energy to the mines over an 18-mile three-phase transmission line. Mr. Still is an English engineer well known as the author of standard books on electrical subjects and as a frequent contributor to the technical journals. He is a member of the British Institution of Electrical Engineers and of the American Institute of Electrical Engineers.

Mr. E. S. Keefer, manager for many years of the construction department of the Western Electric Company and long identified in this capacity with all phases of the supply and contracting business, was unanimously elected the first honorary member of the National Electrical Contractors' Association at its Denver convention. Mr. Keefer was largely responsible for the formation of this important association, and his untiring efforts contributed largely to its success. Mr. Keefer is now associated with the Western Electric Company as a special representative, in which capacity he will co-operate with the managers and sales managers of the company's various branches throughout the country in promoting the patronage of the contracting trade.

Mr. Samuel A. Freshney has been appointed general manager of the Union Electric Company, of Dubuque, Ia., succeeding Mr. Paul B. Sawyer, who resigned Aug. 1 to join the staff of the Electric Bond & Share Company, New York. Mr. Freshney has been engaged in public-utility work for a number of years, beginning his electrical experience in the factory of the old Brush Electric Company at Cleveland, Ohio. After sales experience in the Brush organization, he was appointed general manager of the Muskegon (Mich.) Traction & Light Company, and later served as Cincinnati sales manager for the Fort Wayne Electric Works. Returning to the Muskegon company in 1905, Mr. Freshney later removed to Grand Rapids, Mich., where for seven years he acted as general superintendent for the Board of Public Works.

Mr. Thomas E. Spence, who for the past four years has been in the employ of the American Gas Company of Philadelphia as an expert on industrial power problems relating to the use of central-station energy, was born of Scotch and English parents in 1882 at Jamaica, British West Indies. He came to the United States at an early age and was educated at the University of Colorado. Soon after he became interested as an engineer in the sale of electrical energy on purely economic and engineering principles. Through his investigations and efforts the Luzerne County Gas & Electric Company, of Plymouth, Pa., has acquired a very large motor load from the many anthracite-coal mines located within its territory, demonstrating that a central station can buy coal from a mining company, use it for generating electricity and sell the electricity to the mining company at a price less than that for which the mining company could make it. Mr. Spence has contributed to the literature of the industry from time to time articles on subjects in which he has specialized.

T. E. SPENCE.

Construction

TUSKEGEE, ALA.—All bids received June 24 for the construction of a central power plant at the Tuskegee Norman and Industrial Institute, Tuskegee, have been rejected and new bids will soon be called for. W. G. Franz, Union Trust Building, Cincinnati, Ohio, is consulting engineer.

FORT LISCUM, ALASKA.—Bids will be received at the office of the depot quartermaster, Washington, D. C., until Aug. 15 for furnishing electric fixtures, shades, wattmeters, street lamps, etc., for Fort Liscum, Alaska. H. L. Pettus is depot quartermaster.

PRESCOTT, ARIZ.—The City Council has entered into a contract with the Arizona Pwr. Co. to supply electricity to operate the pumps at the several pumping stations.

ELDORADO, ARK.—The Eldorado Lt. & Wtr. Co. is rebuilding its plant, which was recently destroyed by fire. When completed a day service will be established and power furnished for manufacturing purposes.

MANSFIELD, ARK.—The El. Lt. & Pwr. Co., Huntington, is contemplating extending its transmission lines to Mansfield.

COACHELLA VALLEY, CAL.—A company is being formed for the purpose of installing an electric power system in Coachella Valley. The plans include the erection of 25 miles of trunk transmission lines and about 40 miles of branch lines.

EL SEGUNDO, CAL.—The Southern California Edison Co. is extending its transmission lines into subdivisions back of this place, where many motor-driven pumps are being installed.

FRESNO, CAL.—The San Joaquin Lt. & Pwr. Co. is preparing plans for the erection of a high-tension transmission line over the coast range to the small city plants which have been purchased by the company, work on which will soon begin.

GLENDALE, CAL.—Preparations are being made by the Pacific El. Ry. Co. for making preliminary surveys for an electric railway in East Glendale and through Verdugo Pass into La Canada Valley.

GLENDALE, CAL.—Preparations are being made by the city of Glendale for the erection of a 33,000-volt transmission line from the municipal plant in Pasadena to supply electricity here until power from the Los Angeles aqueduct power plant is available.

LAKEPORT, CAL.—The Mount Konocti Lt. & Pwr. Co. has applied to the State Railroad Commission for permission to extend its transmission lines from Lakeport to Kerseyville, Blue Lakes and Upper Lake, a distance of 25 miles.

LOS ANGELES, CAL.—Bids are being received by the Aqueduct Power Bureau for strain and suspension-type insulators for the 110,000-volt steel-tower line. H. B. Ferris is secretary of the bureau.

LOS ANGELES, CAL.—The Board of Public Works has granted the Southern California Edison Co. an extension of time until Aug. 31 in which to install cables for ornamental lamps on Harvard Boulevard and Third Avenue.

MONROVIA, CAL.—Plans are being considered for improvements to the water and light system in Monrovia.

NAPA, CAL.—The State Board of Control has awarded the contract for supplying electricity to the Napa State Hospital, at Napa, to the Great Western Pwr. Co.

PASADENA, CAL.—The city is preparing to rehabilitate its present telephone system in the public schools.

PETALUMA, CAL.—At a special election held recently the voters ratified the franchise granted the Great Western Pwr. Co. by the Council.

ROSEVILLE, CAL.—The Great Western Pwr. Co. has applied to the State Railroad Commission for permission to erect a high-tension transmission line to the city of Roseville. If granted a franchise, work will begin immediately on erection of the line.

SAN FRANCISCO, CAL.—The Pacific Gas & El. Co., San Francisco, has applied for permission to erect another transmission line down the Mission Road in order to increase its service at Daly City.

TULARE, CAL.—The State Railroad Commission has granted the San Joaquin Lt. & Pwr. Co. permission to extend its transmission lines in Tulare, Kern and Kings Counties.

VALLEJO, CAL.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 31 for furnishing three electrically driven dock capstans at the navy yard, Mare Island, Cal. Plans and specifications may be obtained on application to the bureau or to the commandant of the navy yard named. William M. Smith is acting chief of bureau.

WATSONVILLE, CAL.—The Coast Counties Lt. & Pwr. Co. will begin work at once on the erection of a transmission line to the beach to supply electricity for lamps. A branch line will be extended to the ranch of R. W. Eaton in the San Andreas district to supply power to be used in pumping out the water in the slough there.

WASHINGTON, D. C.—An American firm in Mexico is planning to erect a new factory for the manufacture of clothing, mattresses, etc., to be equipped with the latest electrical improvements. The company is in the market for machinery for the plant, also for other apparatus. Electric fans, motors and accessories will be needed. For further information address No. 9248, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

AUGUSTA, GA.—The stockholders of the Augusta-Aiken Ry. & Lt. Corpn. have ratified the agreement with the Georgia-Carolina Pwr. Co., the Georgia-Carolina Investment Co. and the Electrical Finance Co., providing for the construction of a hydroelectric plant on Stevens Creek. The Georgia-Carolina Pwr. Co. will issue $2,500,000 in bonds to construct the plant.

EATONTON, GA.—A committee has been appointed by the City Council to make investigations and secure estimates for the installation of an electric-light plant in connection with the municipal water-works system. W. S. Smith, R. K. Matthews and J. M. Rainey are members of the committee.

JACKSON, GA.—Arrangements are being made by the City Council for extensions to electric-light system and water mains, for which $6,000 in bonds has been voted.

ORFINO, IDAHO.—Extensive improvements will be made to the Orfino electric light and power plant, which was recently taken over by the Welch interests, of Portland, Ore.

CARLINVILLE, ILL.—Improvements will be made to the local electric plant, which was recently purchased by the McKinley system. The company has been awarded a contract to supply power to the Macoupin County Almshouse, near this city.

CENTRALIA, ILL.—The Centralia El. Lt. Co. is erecting a transmission line to Sandoval, 6 miles distant, where the company has secured a contract to light the streets of the village and a franchise to furnish electricity for commercial and residence lighting.

CHARLESTON, ILL.—The City Council has authorized a contract with the Central Illinois Pub. Ser. Co. for pumping water at the water-works station by electricity.

KINCAID, ILL.—Plans are being considered by F. S. Peabody, Chicago, a prominent coal-mine operator, who owns several coal mines and tracts of coal land in Christain County and nearby counties in central Illinois, for the development of coal mines and the construction of an electric power plant to be operated by coal from the mine. The initial installation will provide for about 2000 kw and will be used to operate hoisting and other machinery in the mines. Mr. Peabody has purchased several of the central-station plants in Edinburg, Pawnee and Nokomis, which will be operated in connection with the plant in Kincaid.

LA SALLE, ILL.—An ordinance has been introduced into the City Council asking that all electric wires in the city be placed underground.

MARSHALL, ILL.—Plans are being considered to consolidate the municipal electric-light and the water-works plants. New equipment, it is understood, will be required. The Erhman Overall Co., of Terre Haute, Ind., it is reported, will establish a branch factory here, to be equipped with electric-motor-driven machinery if sufficient power can be secured.

MATHERSVILLE, ILL.—The Mathersville Lt. & Pwr. Co. has been granted a franchise to install a light and power plant here. The company is capitalized at $10,000.

MOLINE, ILL.—The voters have approved the propositions to grant 25-year franchises to the Central Union Tel. Co. and the Tri-City Automatic Home Tel. Co. If the latter company secures franchises in Rock Island, Ill., and Davenport, Ia., a plant costnig about $2,000,000 will be erected.

MONMOUTH, ILL.—The Rock Island Southern Ry. Co. is planning to erect a transmission line from its power plant at Edwards River to Burlington, Ia., to supply electricity to the People's Gas & El. Co. Two surveys will be made, one of which, it is reported, may be used later for an interurban railway from Monmouth to Burlington.

PINCKNEYVILLE, ILL.—The Pinckneyville Lt., Ice & Pwr. Co. is planning to install a 20-ton ice plant in connection with its light plant and would like to receive prices on ice-making machinery. E. K. Kane is secretary and treasurer.

SPRINGFIELD, ILL.—The Springfield Northwestern Interurban Ry. Co. has petitioned the City Council for a franchise to build its railway on Eighth Street from Carpenter Street to the north city limits.

FORT WAYNE, IND.—The electric plant of the Fort Wayne & Northern Indiana Trac. Co., on Superior Street, was badly damaged by fire, causing a loss of about $70,000.

SHELBYVILLE, IND.—The Indiana Ser. Co., which recently took over a number of water and light plants in this State, is planning to extend its transmisson lines to all the smaller towns in the county as well as to other thickly populated sections. Negotiations are under way with the towns of Morristown, Waldron, Fairland and Flat Rock. E. M. Carr, of New Castle, is superintendent.

WINONA, IND.—Arrangements have been made with the Winona El. Lt. Co. to furnish electricity for lighting the Kosciusko Infirmary. The company will erect a transmission line to the poor farm to supply the service.

CARLISLE, IA.—A special election will be called to vote on the proposition of installing an electric-light system in Carlisle.

CEDAR FALLS, IA.—The installation of a complete new lighting system here is under consideration. The franchise of the Citizens' Gas & El. Co., which now supplies electrical service in Cedar Falls, expired in June.

ELDORA, IA.—Initial steps have been taken by the Park Dam Co., Eldora, to obtain control of the lighting system of several Hardin County

towns by the purchase of the property of the Union El. Pwr. Co., of Union. The Park Dam Co. proposes to supply electricity for the towns of Union and Gifford from the local plant. Work will begin at once on the installation of the system. The local company already operates a plant in Steamboat Rock.

FORT DODGE, IA.—The contract for the construction of a 30-ft. dam and hydroelectric power plant for the Northern Iowa Pwr. Co. in Fort Dodge has been awarded to James Stewart & Co. The cost of the plant complete is estimated at about $500,000.

FORT MADISON, IA.—The Mississippi River Pwr. Co., Keokuk, has applied to the City Council for a franchise to supply electricity here.

GLENWOOD, IA.—The Glenwood El. Lt. & Pwr. Co. is contemplating extending its transmission line to Henderson, and has submitted a proposition to furnish electricity in Hastings. The company has offered to pay the cost of an election to vote on the proposition.

GRUNDY CENTER, IA.—A movement has been started to install a new street-lighting system here. It is proposed to replace the present arc lamps with incandescent lamps of 32 cp.

HASTINGS, IA.—A special election will be called by the City Council to vote on the proposition to grant a franchise to the Central Station Engineering Co., of Glenwood, to install a distributing system and to supply electricity in Hastings.

MARSHALLTOWN, IA.—Application has been made to the Councils of Montour and LeGrand by W. G. Dows and J. A. Reed, of Cedar Rapids, who have taken over the local public utilities, for a franchise to supply electricity for lamps and motors. An election will be held in both towns on Aug. 13 to vote on the proposition.

SLATER, IA.—The Boone El. Co., Boone, has been granted a 25-year franchise to install and operate an electric-light system here.

SWEA CITY, IA.—The installation of an electric-light system here is under consideration.

CLEARWATER, KAN.—At an election held recently the proposition to issue bonds to the amount of $32,000 for the installation of an electric-light plant and water-works system was carried.

HUTCHINSON, KAN.—F. D. Larabee, president of the Larabee Flour Mills Co., of Larabee, has contracted with the United Wtr., Gas & El. Co. for electrical energy to the amount of 570 hp to operate the mills. The steam plant now in use will be discarded. A special high-tension line will be erected from the power plant to the Larabee mills. Additional equipment is being installed in the power plant to enable the power company to provide a 24-hour service for the mills.

SALINA, KAN.—The installation of an ornamental street-lighting system in the business district is under consideration.

COVINGTON, KY.—The City Council is considering the question of requiring all overhead wires in the business district placed underground.

GLASGOW, KY.—The local electric-light and ice plant, owned by Bowen Brothers, Glasgow, has been purchased by Dickinson Brothers, P. W. Holman and W. F. Richardson, all of Glasgow.

LOUISVILLE, KY.—The Louisville Ltg. Co. is reported to be negotiating with the Louisville Ry. Co. with a view of supplying electricity to operate the railway system of the latter company. The Louisville Ry. Co. is building a large power plant, which the lighting company proposes to purchase. George H. Harries is president of the lighting company and T. J. Minary president of the railway company.

TAYLORSVILLE, KY.—Henry Brothers have purchased an electric-light franchise in Taylorsville and will purchase equipment for an electric plant. An oil engine will probably be used.

WILLIAMSTOWN, KY.—The installation of an electric-light plant here is under consideration. J. A. Shoop, Danville, is interested.

WINCHESTER, KY.—Plans are being considered by George Tomlinson for the construction of a large woodworking plant to manufacture tobacco hogsheads. The plans include the installation of an electric plant to furnish electricity for lamps and motors for the factory.

JENNINGS, LA.—Plans are being considered by the Lake Arthur, Jennings & Northern R. R. Co. for the construction of an electric power plant to furnish electricity to operate the proposed railway and for industries along the line. The plant will be located in Jennings and cost about $250,000. W. B. Conover is president and B. B. Bliss secretary. S. Wexler, vice-president of the Whitney-Central Bank, of New Orleans, is interested.

NEW ORLEANS, LA.—Bids will be received at the office of the Sewerage and Water Board, Room 508, City Hall Annex, New Orleans, La., until Sept. 19, for furnishing and erecting complete, ready for operating, the piping and auxiliaries for power house No. 2. Specifications and blank form of proposal can be obtained on application to the above office. A deposit of $10 will be required for each set of plans, which will be refunded upon return of same. F. S. Shields is secretary and George G. Earl general superintendent.

CALAIS, MAINE.—The St. Croix Paper Co. has awarded the contract for building a dam 40 ft. high and 1200 ft. long at Grand Falls, Maine, to the American Hydraulic Construction Co., Boston, Mass.

BOSTON, MASS.—It is reported that the New York, New Haven & Hartford R. R. Co. has decided to equip the Boston & Providence Railroad for electrical operation and also to four-track the same between Boston and Providence, a distance of 42 miles. Work may be started this fall. The cost of the work is estimated at between $6,500,000 and $7,000,000.

CLINTON, MASS.—The Metropolitan Water Board has decided to operate the sewage-pumping station by electricity, the power plant at the Wachusett dam to furnish the power. The present steam plant will be held for use in emergencies.

FITCHBURG, MASS.—Preparations are being made by the Connecticut River Pwr. Transmission Co. to extend its transmission lines from Gardner to Fitzwilliam Depot, N. H., a distance of about 12 miles. A substation will be erected at Fitzwilliam to distribute electricity for lamps and motors. Later it is expected that the line will be extended to Richmond and Winchester.

MITTINEAGUE, MASS.—The Strathmore Paper Co. is planning extensive improvements to its mills in Mittineague, involving an expenditure of from $25,000 to $50,000. The old steam-power plant will be replaced by a 1500-hp steam turbine with generators and motors to drive all the machinery in the factories. Most of the machinery has been purchased.

NEW BEDFORD, MASS.—Application has been made to the Selectmen of Padanaram by the New Bedford Gas & Edison Lt. Co., the Southern Massachusetts Tele. Co. and the Union Street Ry. Co. for pole locations in the town. Arrangements have been made by the gas company to use the poles of the telephone company and the street-railway company where it is possible. The lighting company is planning to extend its transmission lines to Padanaram to supply electricity for residential lighting.

TURNERS FALLS, MASS.—The Amherst Pwr. Co., a subsidiary of the Turners Falls Co., is securing right-of-way through Granby and Fairview for its transmission line which is to carry electricity into the city of Chicopee. The line will be erected on steel towers. The Turners Falls Co. recently secured a contract for furnishing power in Holyoke, which will be transmitted over the same line.

WORCESTER, MASS.—Plans are being prepared by the Worcester El. Lt. Co. for the erecton of a substation in South Worcester, probably near Tainter Street, to cost about $25,000. The company has contracts to furnish electricity to the Worcester Machine Co., the Hammond Reed Co., Rice, Barton & Fales Co. and other concerns in that vicinity.

GRAND RAPIDS, MICH.—At an election held July 24 in East Grand Rapids the proposition to grant the Grand Rapids-Muskegon Pwr. Co. a franchise was carried.

IONIA, MICH.—Options are being taken on the lowlands east of Cleveland street, having in view a proposition to build a power dam, to cost about $125,000. It is estimated that 600 hp could be developed. J. W. Faussett, of Howell, and Norman Birkhart, of Detroit, are interested in the project.

ANOKA, MINN.—Plans are being considered for extension of a transmission line from the municipal electric-light plant in Anoka to Elk River to furnish electricity for lamps and motors in that village.

CANBY, MINN.—The City Council has awarded the contract for street lighting to the Citizens' Lt., Ht. & Pwr. Co. The contract includes ornamental lamps on two blocks, using South Park Foundry & Machine Co.'s lamp standards. Emil W. Erick is general manager.

EDEN VALLEY, MINN.—The Lethert El. Co., St. Paul, has been granted a franchise to establish an electric-light plant here. A power plant of sufficient output to supply electricity to surrounding villages will be erected.

LE SUEUR, MINN.—W. T. McCaskey and James P. Porteus, of Lansing, Mich., have purchased a site in Le Sueur on which they expect to erect an electric-light plant.

LUVERNE, MINN.—Bonds to the amount of $10,000 have been voted, the proceeds to be used for remodeling the municipal electric-light plant and establishing a day service.

MARSHALL, MINN.—Steps have been taken to interest business men in establishing a cluster-lamp lighting system. F. S. Cook, W. C. Haney and L. E. Ijams are interested.

WATERTOWN, MINN.—A franchise has been granted to H. B. Rutledge, secretary and manager of the Glencoe El. Lt. Co., Glencoe, to install and operate an electric-light system in Watertown.

AVA, MO.—George W. Wright, Springfield, Mo., has submitted a proposition to the city of Ava offering to install an electric-light plant, provided a 20-year franchise is granted.

BOONVILLE, MO.—Funds have been raised by the Boonville Commercial Club for the installation of an ornamental street-lighting system on five or six blocks.

HOPKINS, MO.—A proposition has been submitted to the business men of the town by Richard Kuchs, president of the Maryville El. Lt. & Pwr. Co., relative to the organization of a company in this town for the purpose of installing an electric-light system. It is proposed to secure electricity from the plant of the Maryville company and to supply electrical service in Pickering and Hopkins and to farmers along the route of the transmission line.

SEDALIA, MO.—A new light and traction company has been organized at Sedalia by C. E. Murray, R. A. McGregor and J. E. Harsh, all of Joplin, Mo. The company is capitalized at $1,500,000 and proposes to develop natural gas and generate gas and electricity for distribution in the city of Sedalia.

HELENA, MONT.—The City Council has adopted the resolution creating the district for an ornamental lighting system and has also adopted the plans and specifications for the lamps.

LIBBY, MONT.—The Kootenai Pwr. Constr. Co. is planning to build a large power dam at Kootenai Falls, west of Libby, and a hydroelectric plant at a cost of $6,000,000.

RED LODGE, MONT.—Property owners in the business district have petitioned the Council for the installation of cluster lamps on five blocks.

ELWOOD, NEB.—The contract for construction of a new electric-light plant for the village of Elwood has been awarded to the Alamo Engine & Sup. Co., Omaha, Neb., for $6,033.

HASTINGS, NEB.—A movement has been inaugurated for extending the ornamental street-lighting system in First Street from Denver Avenue to Lincoln Avenue.

DOVER, N. H.—The installation of an ornamental street-lighting system in the business district is under consideration.

CAMDEN, N. J.—The City Council has engaged Runyon & Carey, Newark, consulting engineers, to prepare plans for the proposed municipal electric-light plant. If plans are accepted, the same engineers are to supervise the erection of the plant and superintend its operation for one year.

ALDEN, N. Y.—The Depew & Lancaster Lt., Pwr. & Conduit Co. has received authority from the Public Service Commission to exercise franchise for furnishing electricity within the town of Alden, outside of the village of Alden.

AUBURN, N. Y.—The State Prison Department is installing two waterwheels at the outlet of Owasco Lake, at a cost of $5,000, for the purpose of generating electricity for lighting Auburn State Prison. Plans are also being considered by the State Prison Department to generate power from an unused dam across Chazy Lake and transmit it to Clinton Prison, at Dannemora, a distance of 8 miles.

BINGHAMTON, N. Y.—Plans have been announced for the construction of a hydroelectric power plant, which is to impound the waters of two rivers at Whitney Point, at a cost of $3,000,000. The power will be used to generate electricity for an electric railway between Utica and Binghamton and for commercial purposes to cities and towns along the line. Thomas F. McBride, of Clinton, is promoter.

BUFFALO, N. Y.—The Public Service Commission has denied the application of the International Trac. Ry. Co. for a certificate of public convenience and necessity. The construction of the proposed railroad was a part of the general scheme for the reorganization of the entire street-railroad system of the city of Buffalo. The plan has been abandoned and another one substituted.

BUFFALO, N. Y.—Sealed proposals will be received by Dr. Andrew S. Draper, commissioner of education, at State Normal College, Albany, until Aug. 20 for construction, heating, plumbing and gas piping and electric work for the State Normal School Building, Buffalo, N. Y. Only separate bids will be received and no combined bids will be considered. Plans and specifications may be consulted and blank forms of proposals obtained at the State Normal School, Buffalo, and at the office of Herman W. Hoefer, state architect, Capitol, Albany.

CANAJOHARIE, N. Y.—The Montgomery El. Lt. & Pwr. Co. has completed its transmission line to Sharon Springs, a distance of 9 miles. A branch line will be erected from this line to the hamlets of Buel and Sprout Brook, in the town of Canajoharie. The Sharon Springs line will probably be extended to Cherry Valley and to Cobleskill.

COOPERSTOWN, N. Y.—The Clinton Mills Pwr. Co. is planning to build a power house, 50 ft. x 30 ft., plans for whch have been prepared by C. Kiehm, engineer, Utica, N. Y.

GENEVA, N. Y.—Preparations are being made by the Central New York Gas & El. Co. for the erection of a transmission line from Geneva to Seneca Castle for the purpose of supplying electricity at that place. Electrical service will also be furnished to residents along the proposed line. The company is also planning to build an addition to its Geneva power plant, which will provide room for a new boiler recently installed and a 1750-kw generator. It is expected that new equipment to supplement the 750-hp turbine generator will be installed and ready for use by Sept. 1.

LOCKPORT, N. Y.—John Moon, president of the Chamber of Commerce, has requested the Board of Aldermen to insist that the Lockport Lt., Ht. & Pwr. Co. install a new lighting system on Main Street, from Elm to Transit Street, in compliance with the recommendation of the committee on lamps and gas, adopted a year ago.

MECHANICSVILLE, N. Y.—A special election has been called to be held on Aug. 5 to vote on the proposition of granting an electric-light franchise to Mrs. Florence E. Gilliland, who if granted a franchise proposes to secure electricity from the Wapsie Pwr. & Lt. Co., of Mount Vernon, to operate the system.

NEWFANE, N. Y.—The Public Service Commission has given its approval to the application of the Newfane El. Co. to exercise a franchise for furnishing electricity in the town of Newfane.

NEW YORK, N. Y.—The contract for installing electric equipment in Public School 45, borough of the Bronx, has been awarded to Eugene Frank, 22 East Twenty-first Street, New York, for $10,880. C. B. J. Snyder is superintendent of school buildings.

NEW YORK, N. Y.—The Manhattan Bridge Three-Cent Line has applied to Public Service Commission for permission to increase its capital stock from $50,000 to $1,000,000 and for the issuance of $200,000 immediately, to be applied to the assembling of the road, plant and equipment.

NEW YORK, N. Y.—The Public Service Commission has executed two contracts for the construction of additional sections, 2-A and 14, of the Lexington Avenue subway. Section 2-A embraces the Canal Street station on the Broadway part of the Lexington Avenue route and was awarded to the O'Rourke Engineering Constr. Co., 345 Fifth Avenue, New York, for $912,351; section 14 consists almost entirely of tunnels under the Harlem River to carry the new subway from Manhattan into the Bronx and was awarded to Arthur McMullen and Olaf Hoff, 149 Broadway, New York, for $3,889,775.

NEW YORK, N. Y.—Sealed proposals will be received by the State Hospital Commission, Capitol, Albany, until Aug. 14, for furnishing and installing conduit, steam and return mains between main building and east building at Manhattan State Hospital, Ward's Island. Drawings and specifications may be consulted and blank forms of proposal obtained at the Manhattan State Hospital, Ward's Island; at the office of the State Hospital Commission, 1 Madison Avenue, New York, and at the office of Herman W. Hoefer, state architect, Capitol, Albany. Plans and specifications may be obtained upon application to the state architect. T. E. McGarr is secretary of the commission .

SOUTHAMPTON, N. Y.—The Suffolk Lt., Ht. & Pwr. Co. has applied to the Public Service Commission for authority to issue $47,500 in bonds, the proceeds of $22,000 to be used for the purchase of the distributing system of the Riverhead El. Lt. Co. at Westhampton Beach.

UTICA, N. Y.—The City Council has contracted with the General El. Co., Schenectady, and the Ornamental Lighting Pole Co., New York, for the installation of 60 luminous arc lamps on Genesee street. The lamps are for the first section of the "luminous way," which in all will require about 300 lamps.

WHITE PLAINS, N. Y.—The Board of Village Trustees has adopted a resolution authorizing the committee on gas and electricity to make investigations and report to the board as to the feasibility of establishing a municipal electric-light plant. The village now pays $18,000 annually for street lighting. Bids will also be received until Aug. 26 for lighting the village. The present contract expires April 1, 1913.

WILSON, N. Y.—The Conant-Bryant Pwr. Co. is negotiating with the Niagara, Lockport & Ontario Pwr. Co. to secure power in order to meet the increasing demand for electrical service here.

WILSON, N. Y.—The Public Service Commission has denied the application of the Lewiston & Ontario Pwr. Co. to exercise franchises in the town and village of Wilson. The company is, however, given permission to renew its application if the Conant-Bryan Pwr. Co., now operating here, shall not present to the commission, at a hearing to be held at Buffalo on Aug. 3, proof that it has entered into a contract with the Niagara, Lockport & Ontario Pwr. Co. for power so that it will be able to meet the demands for electrical service in the town and village of Wilson.

YONKERS, N. Y.—Plans are being considered for organizing a new company under the name of the Triangle Ltg. Co. for the purpose of installing an electric-light plant to supply electricity for the merchants on Main Street and North Broadway. A. E. Hamilton, M. Dee, Thomas Dee and William Barlow are interested.

COOLEEMEE, N. C.—Tucker & Laxton, Realty Building, Charlotte, N. C., are reported to have secured the contract for the installation of an electric-light plant for the Erwin Cotton Mills; also to furnish 100 street lamps for the town and for lamps and motors for the lodge of W. R. Craig, of Craig & Jenks, New York, N. Y.

SCOTLAND NECK, N. C.—Plans are being considered by the town commissioners for the installation of a larger generator in the municipal electric-light plant. L. R. Mills, Jr., is superintendent.

BARBERTON, OHIO.—An ordinance calling for plans and specifications for a municipal electric-light plant is now in the hands of a committee and, it is expected, will be submitted at the next meeting of the Council. The Barberton Lt. & Pwr. Co. has applied for a new franchise for a period of 17 years.

BEACH CITY, OHIO.—Application has been made by Mrs. Orpha Gilmore, Beach City, to the Public Service Commission for permission to purchase the plant of the Beach City Pwr. Co.

BRADFORD, OHIO.—Plans are being considered by the Pan Handle Co. for the installation of an electric power plant in Bradford, to cost about $40,000, to provide electricity for more of the work and to light the parks.

CLEVELAND, OHIO.—The Cleveland El. Illg. Co. has closed a contract with the Cleveland & Eastern Trac. Co., whereby it will furnish the traction company with energy to operate its system, 39 miles in length, above the amount which will be generated at the railway company's power house at Gates' Mills. The contract is for a period of 10 years.

CLEVELAND, OHIO.—Sealed bids will be received at the office of W. H. Kirby, secretary of the director of public service, 104 City Hall, Cleveland, until Aug. 9 for furnishing poles for the municipal electric-light plant. Bids will also be received at the same time and place for electric meters and for copper wire for the municipal electric plant. W. J. Springborn is director of public service.

MASSILLON, OHIO.—The Massillon El. & Gas Co. has asked the City Council to extend its present street-lighting contract from April, 1916, to April, 1922, in return for which the company offers to install new magnetite-arc lamps to replace the lamps in use, at a cost of about $11,000, and also offers to maintain the lamps on an all-night and every-night schedule instead of the moonlight schedule, as heretofore, at the cost of the present service.

RIPLEY, OHIO.—The City Council has offered the Ripley Gas Lt. & Coke Co. $17,000 for its electric plant. The company values the property at $25,000 and has a contract with the city amounting to $5,000 per year.

TOLEDO, OHIO.—The public improvement committee has approved an ordinance granting the Toledo Sugar Co. permission to erect and maintain transmission lines along Main Street from the corporation line on the south to the easterly line of the Oregon Road to the intersection of Miami Street. This line will supply electricity to the company's pumping station in the vicinity of the C., H. & D. docks.

TOLEDO, OHIO.—The Public Service Commission has authorized the sale of the property of the Toledo, Port Clinton & Lakeside Ry. Co., which operates an electric railway between Toledo and Lakeside, 50 miles long, and which furnishes electricity for lamps and motors to numerous towns along the route, to the Northwestern Ohio Ry. & Pwr. Co. The commission also granted the Northwestern company permission to issue $1,100,000 in bonds, the proceeds to be used to purchase the property. A request for $200,000 additional for improvements will be further considered.

WELLSVILLE, OHIO.—The City Council has passed an ordinance calling for a second vote and election on the question of issuing $60,000 in bonds for the installation of a municipal electric-light plant.

OKLAHOMA CITY, OKLA.—The Oklahoma City Land & Devel. Co. has made arrangements with the Oklahoma Ry. Co. to purchase electricity to operate its railway to Northeast Park.

ARLINGTON, ORE.—The City Council is considering the question of installing an electric-light plant and a new engine for the water-works systems, the improvements to cost about $9,000.

BAKER, ORE.—The Idaho-Oregon Pwr. Co., with headquarters at Boise, Idaho, is contemplating extending its transmission lines into this territory.

EUGENE, ORE.—The City Council has entered into a contract with the Eugene Water Board for street lighting for a period of two years, under which the city is to pay $552.60 per month. The board also agrees to maintain additional lamps at $1.27 per month, the Council to provide for installation.

NEWBERG, ORE.—The City Council has granted the Yamhill El. Co. a 25-year franchise for lighting the city.

SALEM, ORE.—The Southern Pacific Co. has purchased the Salem, Falls City & Western R. R. and will equip it for electrical operation within the next year, to be operated as part of its electric traction system. D. W. Campbell, general superintendent of the Southern Pacific Co., has been elected president.

SPRINGFIELD, ORE.—The installation of a cluster-lamp street-lighting system is under consideration.

SPRINGFIELD, ORE.—The McKenzie Valley Irrig. & Pwr. Co. has been granted permission by the State Engineer and the Forest Service to construct a hydroelectric power plant at the outlet of Clear Lake on the McKenzie River. J. A. Yamgreen is president.

PANAMA.—Proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Aug. 6, for furnishing substation equipment, including transformers, switchboard, oil switches and necessary adjuncts, etc. Blanks and general information relating to this circular (No. 722) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y., and 614 Whitney-Central Building, New Orleans, La. Major F. C. Boggs is general purchasing agent.

CYNWYD, PA.—Bids will be received at the office of commissioners, Ardmore, addressed to chairman of health and drainage committee, care of Robley A. Warner, superintendent, P. O. Box 708, until Aug. 14, for construction of a sewage-pumping station, to be equipped with electrically driven centrifugal pumps, plans and specifications for which may be seen at the above office.

PITTSBURGH, PA.—The West Penn Trac. & Wtr. Pwr. Co. has awarded a contract to the T. A. Gillespie Co., Pittsburgh, for the construction of a large dam and power house on the Cheat River in West Virginia, near the Pennsylvania state line, to cost about $1,000,000. Work will begin immediately on the dam.

ROUSEVILLE, PA.—Arrangements are being made to equip the Germania refinery at Rouseville for electrical operation. The equipment, it is understood, will include 25 motors and dynamo.

WAYNE, PA.—The Merion Gas & El. Co. is planning to build an addition to its engine house in Wayne.

WELLSBORO, PA.—The Borough Council has accepted the new contract submitted by the Wellsboro El. Co. for street lighting. Under the new contract the company will install a new system, using tungsten lamps. R. K. Young is president of the company.

ANDERSON, S. C.—Negotiations are under way whereby the Gregg Shoals power plant on the Savannah River will be leased by the Georgia Ry. & Pwr. Co., Atlanta, to the Anderson Wtr., Lt. & Pwr. Co., of Anderson. The plant, which is located about 27 miles from Anderson and has an output of about 3000 hp, will run parallel with the Portman Shoals plant on the Seneca River, owned by the Anderson company, and will furnish electricity to operate the cars of the Greenville, Spartanburg & Anderson Railway Co., manufacturing plants in Abbeville and Greenwood Counties and for lighting the cities of Greenwood and Abbeville. H. A. Orr is president.

COLUMBIA, S. C.—The Georgia-Carolina Pwr. Co., North Augusta, has filed a certificate with the Secretary of State announcing an increase in capital stock from $100,000 to $1,250,000.

CANTON, S. D.—The contract for the construction of a 280-ft. dam across the Sioux River, below Canton, to cost about $100,000, has been awarded to A. H. Latimer.

MILLER, S. D.—At an election held recently the proposition to purchase the plant of the Miller El. Co. to be owned and operated by the municipality was carried.

JONESBORO, TENN.—The Eastern Tennessee El. Co., which is building a hydroelectric power plant on Clinch River, near Greeneville, has taken over the electric-light plant owned by T. F. Hargis, at Jonesboro, which will be converted into a substation as soon as the hydro-electric plant is completed.

ANGELITA, TEX.—O. L. Hubbard, of Chicago, who recently purchased a tract of 2000 acres near here, is preparing to establish a town site upon the property. An electric-light plant, water-works system and other improvements will be established.

GAINESVILLE, TEX.—The Gainesville El. Co. has sold its plant to the Texas Utilities Corpn., of Dallas. The new company contemplates extensive improvements to the system.

PARIS, TEX.—Interests identified with the Texas Pwr. & Lt. Co., Dallas, Tex., have acquired the electric light and power properties of the Paris Lt. & Pwr. Co., the electric and gas properties of the Brownwood Gas & El. Co., Brownwood, and the electric system of the Gainesville El. Co., Gainesville.

PROVO, UTAH.—The Telluride Pwr. Co. has applied to the city commissioners for a franchise to erect a transmission line from its power plant at Olmstead south through Provo to the southern limits of Provo City. It is understood that the line is to extend as far as Springville and will furnish electricity to a number of industrial firms and to its county infirmary south of this city.

FREDERICKSBURG, VA.—The City Council has entered into a contract with the Fredericksburg Pwr. Co. for furnishing electricity for the city and pumping water to the city reservoir for a period of 27 years and 8 months, with the privilege of the city or the company terminating the contract afer 15 years. At present the city is operaing a municipal elecric plant and pumping station.

ROANOKE, VA.—The Roanoke Trac. & Lt. Co. has entered into a contract with the Appalachian Pwr. Co. for electricity from its plant on the New River. Energy will be delivered by the Appalachian company to the substation of the Roanoke company in Roanoke.

BELLINGHAM, WASH.—A high-power switching station will be erected near the site of the present power plant at Stave Lake to handle the current that will be transmitted to the city of Bellingham from the Stave Lake power plant to be utilized by the Whatcom County Ry. & Lt. Co.

BREMERTON, WASH.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 31 for furnishing and installing an electric elevator in the naval hospital at the navy yard, Puget Sound, Wash. Plans and specifications may be obtained on application to the bureau or to the commandant of the navy yard named. William M. Smith is acting chief of bureau.

CONCRETE, WASH.—The Skagit River Tel. Co. is contemplating extending its telephone lines from Rockport to Marblemount, a distance of 10 miles.

SEATTLE, WASH.—The finance committee of the City Council has recommended an appropriation of $25,000 for repairs on the timber dam at Cedar Lake and the two power pipe lines leading from the lake to the power house at Cedar Lake.

VANCOUVER, WASH.—Surveys are being made by the Washington-Oregon Corpn. for its proposed electric railway from Sifton to Hockinson.

WHEELING, W. VA.—The West Penn Trac. Co., Pittsburgh, Pa., has purchased the property and holdings of the Wheeling Trac. & Wtr. Pwr. Co., which owns the street-railway system in Wheeling and interurban lines, serving about 40 cities and towns in the Ohio Valley. Surveys are being made for the erection of a high-tension transmission line connecting with the West Penn Trac. & Wtr. Pwr. Company's system through Washington.

MADISON, WIS.—Proposals will be received by the Capitol Commission of Wisconsin, Madison, Wis., until Aug. 13 for furnishing material and labor for the electric work of the interior finish of the great dome and central portion of the Wisconsin State Capitol, under construction at Madison, in accordance with plans and specifications prepared by George B. Post & Sons, architects, which may be examined at

the office of the architects, 347 Fifth Avenue, New York, N. Y.; office of the Capitol Commission, new east wing of the Capitol, Madison; Builders & Traders' Exchange, Milwaukee. Plans may also be obtained by depositing $100 with Lew F. Porter, secretary Capitol Commission, which will be refunded upon return of same. Proposal blanks may be obtained upon application to the secretary of the Capitol Commission.

MILWAUKEE, WIS.—The County Board is considering the question of erecting a power plant at the county insane hospital. A plant of sufficient output to provide for the Agriculture School may be installed.

PORTAGE, WIS.—The Portage El. Lt. & Pwr. Co. has been granted permission by the Wisconsin Commission to issue $75,000 in bonds and $35,000 in capital stock, the proceeds to be used to acquire the property and rights of the Portage El. Co.

WAUPUN, WIS.—Proposals will be received by the State Board of Control, Washington Building, Madison, Wis., until Aug. 6 for furnishing material and constructing power plant complete for the Hospital for Criminal and Violent Insane, at Waupun, Wis., according to plans and specifications prepared by Foeller & Schober, architects, Green Bay, Wis., which are on file at the office of the State Board of Control, Madison; office of the warden of the Wisconsin State Prison, Waupun, and at the office of the architects, Green Bay. Plans and specifications can be obtained on application to the State Board of Control, for which a deposit of $5 will be required. Ralph E. Smith is president of board.

VANCOUVER, B. C., CAN.—The construction of an electric railway between Stave Falls and Port Moody is under consideration. E. H. Heaps is interested in the project.

CORNWALL, ONT., CAN.—New and improved plans for the construction of a dam on the St. Lawrence River at Long Sault, near Cornwall, Ont., are practically completed. Before further steps are taken the new plans will be submitted to the engineering departments of both Canada and the United States.

HARRISTON, ONT., CAN.—J. W. Hansay, of Palmerston, is negotiating with the Town Council for the local electric-light plant, which is at present closed down.

TORONTO, ONT., CAN.—The judicial committee of the Privy Council has reversed the judgment of the Court of Appeal of Ontario, delivered on Feb. 1, in the case of the Toronto & Niagara Pwr. Co. The Privy Council finds that the company is entitled to erect transmission lines along the streets of North Toronto for the distribution of electricity without the consent of the city corporation. The proposition in regard to which the company and the city of Toronto came in conflict was that of the erection of a transmission line from Niagara to this city carrying 85,000 volts. The company recently decided to devote $3,000,000 to extensions of its system at Niagara whereby in addition to the three units being erected in the power station at Niagara Falls four others are to be installed, bringing up the total generating capacity of the plant to 125,000 hp.

MOOSE JAW, SASK., CAN.—Sealed tenders will be received by the city commissioners until Aug. 9 for furnishing and installing a 12-panel switchboard, plans and specifications for which may be obtained on application to J. D. Peters, electrical superintendent.

REGINA, SASK., CAN.—Tenders will be received by the city commissioners until Sept. 14 for the following equipment: One 1500-kw steam turbine unit, one switchboard panel, surface condenser for turbine, one 25-kw motor-driven exciter. Specifications may be obtained on application to the office of the city electrician. A. W. Pool is city clerk.

TAMPICO, TAMAULIPAS, MEX.—S. Pearson & Son, Ltd., who recently acquired the two local electric plants and the street-railway system, operated by mules, have submitted to the City Council plans for improvements to the electric plants and street railway which will involve an expenditure of about $3,500,000. The work will include the erection of a large power plant, converting the railway to electric traction and extending the lines to various parts of the city. Plans have also been adopted for constructing an electric interurban railway from Tampico to La Barra, 6 miles distant. Surveys are also being made by S. Pearson & Son, Ltd., for a proposed railway to extend from Tampico to Tuxpam, a distance of 120 miles, which will probably be operated by electricity.

New Industrial Companies

THE BANK ELECTRICAL SUPPLY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Benjamin Berkowitz, Meyer Bank and Pauline Bank, all of New York.

BARLOW'S ELECTRIC GARAGE COMPANY, of Newark, N. J., has been incorporated with a capital stock of $20,000 to do a general automobile business. The incorporators are: W. W. Scofield, D. A. Barlow, 233 High Street, Newark, and William T. Benjamin, 10 Cypress Street, Newark.

THE W. W. DEAN ELECTRICAL LABORATORY CO., of Chicago, Ill., has been incorporated with a capital stock of $25,000 by W. W. Dean, Andrew J. Ryan and Daniel Jerks. The company proposes to do a general laboratory, manufacturing and mercantile business.

THE FARMERS' AUTOMATIC TELEPHONE COMPANY, of Aberdeen, S. D., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing and selling a telephone device recently patented by F. E. Granger, of Aberdeen. The incorporators are: E. Oderkirk, J. L. Zeitlow and S. H. Collins.

THE GARRISON GASOLINE ENGINE SPECIALTIES COMPANY, of Camden, N. J., has been granted a charter with a capital stock of $125,000 to manufacture gasoline engines. The incorporators are: F. A. Kuntz, F. S. Saurman and F. S. Muzzey.

THE HALL'S SANITARY TELEPHONE MOUTHPIECE COMPANY, of San Diego, Cal., has been chartered with a capital of $35,000. The incorporators are: J. Hall, S. H. Hall, Claude Woolman, A. C. Shreve and C. W. Barber.

THE IDEAL FIRE DETECTOR COMPANY, of West Orange, N. J., has been granted a charter wth a capital stock of $25,000 to manufacture and install fire detector apparatus, electrical and mechanical devices, etc. The incorporators are: Charles H. Kayser, West Orange; J. E. Florence and William H. Hampton, New York, N. Y.

THE I-M-S MOTOR COMPANY, of Esopus, N. Y., has been incorporated with a capital stock of $10,000 by H. Cohen, 140 West 111th Street; Emil Adler, 41 Convent Avenue; J. J. Baker, 546 Riverside Drive, all of New York. The company proposes to manufacture motors, engines and machinery.

THE INDEPENDENT POLE & CROSS ARM COMPANY, of Chicago, Ill., has been incorporated by M. F. S. Schmidt, George D. Kimball and Joseph L. Green. The company is capitalized at $10,000 and proposes to manufacture and deal in poles, cross-arms and other materials used in the construction of telephone and telegraph lines.

THE JENNY ELECTRIC STARTER COMPANY, of Indianapolis, Ind., has been incorporated by Charles D. Jenny, Russell Wilson and W. L. Taylor. The company is capitalized at $100,000 and proposes to manufacture and sell electrical and mechanical devices for starting electric motors, gasoline, gas and other explosive engines.

THE LOUISVILLE GAS & ELECTRIC FIXTURE COMPANY, of Louisville, Ky., has been incorporated with a capital stock of $2,000 by Edward T. Martin, Harry D. Catlett and I. P. Barnard.

THE MONARCH DIRECT-CURRENT ELECTRIC TRANSFORMER COMPANY, of Brooklyn, N. Y., has been granted a charter with a capital stock of $100,000 for the purpose of manufacturing electrical apparatus. The incorporators are: R. J. Ward, Richmond Hill; A. A. Lambert, and F. C. Lambert, of Brooklyn, N. Y.

THE NORSTROM ELECTRIC COMPANY, of Chicago, Ill., has been incorporated by Niles E. Norstrom, J. Arthur H. Johnson and Marie Hahn. The company is capitalized at $50,000.

THE THERMALARM COMPANY, of Charlotte, N. C., has been granted a charter with a capital stock of $125,000 for the purpose of doing general electrical work and manufacturing and exploiting electrical appliances. The incorporators are: H. A. Russ, J. P. Lindsay and others.

THE TWINVOLUTE PUMP & MANUFACTURING COMPANY, of Irvington, N. Y., has been incorporated with a capital stock of $125,000 for the purpose of doing a general electrical and mechanical engineering business, manufacturing pumps, etc. The incorporators are F. C. Prindle, Washington, D. C.; L. M. Fish, Newark, N. J., and J. B. Ketcham, New York, N. Y.

New Incorporations

RIVERSIDE, CAL.—The Riverside & Western Ry. Co. has been incorporated with a capital stock of $500,000 by Clarence E. Conlin, Frank T. Lyman and Alfred E. Dennis.

DOVER, DEL.—The Continental Pub. Ser. Co. has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $50,000 and is authorized to do a general utility business, construct, maintain and operate railways, wharfs, docks, ferries, electric-light and gas plants, acquire and hold real estate and secure franchises of all kinds.

DANVILLE, ILL.—The Crawfordsville & Danville Trac. Co. has been incorporated with a capital stock of $10,000 for the purpose of building an electric railway, passing through the towns of Elams, Wallace, Kingman, Cayuga, Perrysville and Silverworth. The route will be either 47 or 54 miles in length. The incorporators are: John A. Shafer, J. F. Edwards and C. B. Marshall, of Indianapolis.

FREEPORT, ILL.—The Freeport Ht. & Fuel Co. has been incorporated with a capital stock of $300,000 to construct and operate a heat, light and power plant. The incorporators are: E. D. Brothers, T. J. Sullivan and J. G. Dee.

BURKESVILLE, KY.—The Burkesville Lt. & Milling Co. has been organized with a capital stock of $1,800 by C. C. Baker, C. R. Payne and J. H. Baker.

GLADWIN, MICH.—The Gladwin Lt. & Pwr. Co. has filed articles of incorporation with the Secretary of State. The company is capitalized at $50,000.

TRAVERSE CITY, MICH.—Articles of incorporation have been filed with the Secretary of State by the Duck Lake Pwr. Co. with a capital stock of $16,000.

COLLIERS, N. Y.—The Colliers Lt., Ht. & Pwr. Co. has been incorporated with a capital stock of $50,000 for the purpose of supplying gas and electricity here. The incorporators are: Louis B. Grant, Bart T. Cavanagh, Peter C. Schutrum and Arthur McCausland. Colliers has not a post office.

BUTLER, PA.—Notice of application for charters for five new companies in Butler County has been filed with the State Department as follows: The Summit Township El. Co., the Winfield Township El. Co., the Buffalo Township El. Co., the Jefferson Township El. Co. and the Butler Township El. Co. The companies will operate in small towns between Butler and Freeport, along the route of the large trunk line which the West Penn. Elec. Co., of Pittsburgh, is erecting from its power plant near Connellsville.

PHILADELPHIA, PA.—The Folsom & Moore St. Ry. Co. has been granted a charter with a capital stock of $4,000. The directors are: Charles O. Kruger, 820 Dauphin Street, Philadelphia, president; G. W. Mantz, Alexander Rennick, Thomas K. Bell, and Frank W. Janney, all of Philadelphia.

PITTSBURGH, PA.—Charters have been granted by the State Department to the Jefferson Pwr. Co., the Valencia El. Co. and the Spring Hill Township El. Co. to operate in Butler County, with offices in Pittsburgh. The Nicholson Township El. Co. has been granted a charter with a capital stock of $5,000. The office of the company is located in Pittsburgh.

STROUDSBURG, PA.—The Delaware Water Gap El. Co. has been granted a charter with a capital stock of $5,000. The directors are: Arthur D. Lord, New York, N. Y., treasurer; Samuel E. Shull and H. S. Van Etten, Stroudsburg.

SWATARA, PA.—The Union El. Co. has been granted a charter with a capital stock of $5,000 for the purpose of supplying electricity in Derry Township. The incorporators are: Walter J. Bradley, Philadelphia, and C. B. Cassady, Hershey.

COLUMBIA, S. C.—The South Carolina Development Co. has filed articles of incorporation under the laws of the State of Maine. The company is capitalized at $2,000,000 and proposes to develop and operate extensive gas and electrical properties in South Carolina. The headquarters of the company will be located in Columbia. The incorporators are: Herbert A. Wadleigh, Winchester; Wilbur Tusch, Cranford, N. J., and Lincoln G. Ashcroft, Boston, Mass.

MOUNTAIN CITY, TENN.—The Roan Creek Lt. & Pwr. Co. has been organized with a capital stock of $5,000 by R. E. Donnelly, R. H. Butler and J. H. Murphy.

ALICE, TEX.—The Alice Ice & Lt. Co. has been incorporated with a capital stock of $12,000 by George T. Rea, C. H. McShan and E. J. Stevens.

CALDWELL, TEX.—The Caldwell El. Pwr. & Ice Co. has been incorporated with a capital stock of $10,000 by M. L. Womack, C. C. Nelms and George M. Johnson.

COOPER, TEX.—The Delta El. & Mfg. Co. has been incorporated with a capital stock of $15,000 by R. J. Thomas, M. Chester Smith and Charles Hardy.

THERESA, WIS—The Theresa El. Lt. & Pwr. Co. has been incorporated with a capital stock of $7,000 by Nathan Haessley, P. F. Laugenfeld and Henry Felling.

Trade Publications

ELECTRIC HOISTS.—A recent addition to the publications of the General Electric Company is one on electric hoists, which is Bulletin No. 4939, superseding a previous bulletin on the same subject.

EXHAUST STEAM.—A paper read before the Convention of the Wisconsin Engineering Association by Mr. J. A. Bendure, entitled "Central Station Heating, or Conserving the Heat Unit," has been added to the bulletins issued by the American District Steam Company, North Tonawanda, N. Y. It is designated as No. 125.

WATER SUPPLY SYSTEM.—Catalog No. 2022 of the Fort Wayne Engineering & Manufacturing Company is devoted to the non-storage system of water supply. A complete list of parts furnished with each system is given and also a diagram of the general plan of installation for open well and drilled well are given.

WIRE HANDBOOK.—The Standard Underground Cable Company, Pittsburgh, Pa., has brought out another edition of its handbook of price lists, telegraph code and useful information relating to bare and insulated wires and cables, which contains a great deal of general information of much value to the engineer.

GENERATORS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., through its railway and lighting department, has issued Circular No. 1088, on three-wire direct-current generators. It is fully illustrated with cuts of recent installations, and gives a partial list of some recent three-wire installations.

GENERATOR.—The Hydrox electrolytic hydrogen-oxygen gas generator is given brief description and illustration in a four-page leaflet issued by the Electric Storage Battery Company, of Philadelphia. A switchboard for charging ignition and lighting storage batteries is fully described in a four-page leaflet issued by the same company.

FLASHERS FOR ELECTRIC SIGNS.—The Reynolds Electric Flasher Manufacturing Company, 617 West Jackson Boulevard, Chicago, gives in Bulletin No. 21 a large variety of sign and display suggestions, which include all the latest improvements. Some very striking and realistic advertising effects have been produced by the use of flashers, as shown in this bulletin.

WIRE.—The Standard Underground Cable Company, of Pittsburgh, Pa., has issued a 56-page booklet on Colonial copper-clad wire. It is printed in copper and black inks, and contains considerable information of general interest. The various uses for wire in telephone and telegraph systems, signal systems, transmission systems and others are discussed in this little book.

PUMPING ENGINES.—Catalog No. 12 of the Standard Pump & Engine Company, Cleveland, Ohio, tells its story on Standard pumping engines and Standard water-supply systems in a succinct manner, and shows diagrams adapted to shallow wells, cisterns, lakes or rivers and others adapted to pump from deep wells, operating with gas or gasoline engines, electric motor or hand power.

STERILIZERS.—"Water Sterilization by Heat" is the title of a pamphlet issued by the Forbes Company, 1234 Callowhill Street, Philadelphia, Pa. Considerable information on the necessity of sterilizing water is given. A full-page cut showing principle of operation and many full-page cuts of office buildings, hospitals and other public institutions in which the Forbes apparatus has been installed are given.

NEW PIPELESS FIXTURES.—The Albert Sechrist Manufacturing Company, 171-7 Logan Street, Denver, Col., has recently issued Catalog No. 24, size 9¾ in. by 12¾ in., describing its new combination electroliers which by the use of interchangeable parts enable many changes and alterations in design and in number of lamps to be easily and quickly made. A page of information addressed to the trade is followed by numerous line drawings, giving number and price of each electrolier illustrated. A stretcher containing fourteen pictorial views of the various departments of the Sechrist factory is being mailed with this catalog.

Business Notes

P. W. SOTHMAN & COMPANY have opened offices in the Kent Building, Toronto, Canada, as consulting engineers and specialists in hydroelectric development, high-tension transmission and other work connected with the generation and distribution of electrical energy. Associated with Mr. Sothman in the company are Messrs. J. A. Grundige and F. P. Mansbendel.

MORGAN ENGINEERING COMPANY.—The Minnesota Steel Company, of the United States Steel Corporation, has placed a $500,000 order with the Morgan Engineering Company, of Alliance, Ohio, for electric cranes. The order is said to be the largest single crane order ever placed. The machines are from 10 tons to 150 tons in rating and will be installed in the plants at Duluth.

ALUMINUM COMPANY OF AMERICA.—Mr. James W. Rickey, chief engineer of the Long Sault Development Company and the St. Lawrence Power Company, Ltd., and hydraulic engineer for the Aluminum Company of America, has transferred his office from Massena, N. Y., to the executive offices of the Aluminum Company of America, 2402 Oliver Building, Pittsburgh, Pa.

TERRY STEAM TURBINE COMPANY.—The Detroit agency of the Terry Steam Turbine Company has been discontinued. The territory has been divided along the eighty-fifth degree of longitude. The section east of this line is covered by the Cleveland office, of which Mr. L. G. Findlay is manager, while the western section is covered by the Chicago office, of which Mr. A. P. Peck is manager.

FOSTORIA LAMP COMPANY.—The annual summer conference of the salesmen of the Fostoria Incandescent Lamp Company was held from July 14 to 20 at Ballast Island, Ohio, under the general directon of Mr. H. H. Geary. Forty-two men were in attendance, and the meetings were very successful from every standpoint. Among the speakers were Mr. Paul Bauder and Mr. N. H. Boynton, who explained the extensive publicity campaign which is to be conducted during the coming fall and winter for the stimulation of sales of high-efficiency lamps.

TERRY STEAM TURBINE COMPANY.—Recent orders for turbine-driven equipment placed with the Terry Steam Turbine Company, Hartford, Conn., include the following: From the Northern Texas Traction Company, placed through the Stone & Webster Engineering Corporation, for a 100-kw turbine-driven generator set; from the United Electric Light Company, Springfield, Mass., a repeat order for a boiler-feed pump unit; from the Savannah (Ga.) Electric Company, for two 20-hp pump units; from the Consumers' Power Company, St. Paul, Minn., for a 25-hp turbo pump; from the San Diego Gas & Electric Company, Cuba, for one 14-hp and one 105-hp pump unit; from the Los Angeles Gas & Electric Corporation, for two 16-hp pump units; from the Meridian (Miss.) Railway & Light Company, for a 46-hp boiler-feed pump unit, and from the Hillsboro (Ill.) Electric Light & Power Company, for a 10-hp turbine.

Directory of Electrical Associations, Societies, Etc.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary-Treasurer, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention, Birmingham, November, 1912.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual meeting, Chicago, October, 1913.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, 29 West 39th St., New York. Convention, Chicago, Oct. 7-11, 1912.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh Universty, South Bethlehem, Pa. Next general meeting, New York, Sept. 9-11, 1912.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Convention, Richmond, Va., Sept. 3-5, 1912.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 29 West 39th St., New York. Meeting, second Friday of each month, October-May.

AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y. Annual meeting, Cleveland, Ohio, jointly with the American Association for the Advancement of Science, December, 1912.

ARKANSAS ASSOCIATION PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Seattle, Wash. Annual meeting, Hot Springs, Va., Sept. 10-12, 1912.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, Steubenville, Ohio. Annual convention, Hotel Pfister, Milwaukee, Wis., Sept. 23-28, 1912.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-Treasurer, Jos. A. Andreucetti, Chicago & Northwestern Railway, Chicago. Annual convention, Auditorium Hotel, Chicago, Oct. 21-26, 1912.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago. Annual meeting, St. Louis, Mo., May 20, 1913.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Colo.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, Thomas F. Kennedy, 900 15th St., Denver, Colo. Annual meeting, Glenwood Springs, Sept. 12-14, 1912.

ELECTRIC CLUB, CHICAGO. Secretary, W. M. Connelly, 1417 Monadnock Block, Chicago. Meets every Thursday noon.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting, Syracuse, N. Y., January, 1913.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1613 Grand Ave., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Petermann, Milwaukee, Wis. Summer meeting, Waupaca and Chain-of-Lakes, Wis., August 12, 1912.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary-Treasurer, John W. Crum, 1324 Land Title Building, Philadelphia, Pa. Executive Committee meets second and fourth Thursday of each month.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. Secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Assistant Secretary, Harvey Robinson, 124 West 42d St., New York. Meeting, fourth Tuesday of each month. Annual convention, Boston, Oct. 8-9, 1912.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA, NEW ENGLAND SECTION. Secretary, W. E. Holmes, 46 Blackstone St., Boston, Mass. Meetings monthly upon notice.

ELECTRIC VEHICLE CLUB OF BOSTON. Secretary-Treasurer, Leavitt L. Edgar, 39 Boylston St., Boston, Mass. Meeting every Wednesday, 12:30 p. m.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

GAS, ELECTRIC & STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-Treasurer, Prof. H. V. Bozell, Norman, Okla.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Niagara Falls, Ontario, Can., Sept. 16-19, 1912.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, A. Newburger, 1153 Myrtle Ave., Brooklyn, N. Y. Meetings second and fourth Wednesdays, New Grand Hotel, New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, 120 So. Meridian St., Indianapolis, Ind. Annual meeting, Indianapolis, Oct. 16-17, 1912.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS. Secretary, H. J. F. Porter, 29 West 39th Street, New York. Sixth congress, New York, Sept. 3-7, 1912.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Convention, Peoria, Ill., Aug. 26-30, 1912.

INTERNATIONAL COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 W. Indiana St., Chicago. Meeting, second Friday of each month at Lewis Institute.

INTERNATIONAL ELECTROCHEMICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support.) General Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Next meeting at Berlin in 1913.

INSTITUTE OF RADIO ENGINEERS. Secretary, E. J. Simon, 81 New St., New York. Meeting, first Monday of each month.

IOWA ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Annual convention, Waterloo, April 23-24, 1913. Secretary, A. W. Zahm, Mason City, Ia.

IOWA STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual meeting, April, 1913, Waterloo, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT & STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Annual meeting, Manhattan, Kan., Oct. 17-19, 1912.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. H. Bower Spangenberg, 625 Poydras St., New Orleans, La. Meets second Thursday of each month.

MAINE ELECTRIC ASSOCIATION. Secretary, Walter S. Wyman, Waterville, Maine.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, E. F. Strong, Chaska, Minn. Sixth annual convention, March 15-22, 1913.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER WORKS ASSOCIATION. Secretary-Treasurer, P. W. Markham, Brookfield, Mo. Next convention at Mexico, Mo., 1913.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION, CANADIAN SECTION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

NATIONAL ELECTRIC LIGHT ASSOCIATION, COMMERCIAL SECTION. Secretary, P. S. Dodd, 29 West 39th St., New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION, EASTERN NEW YORK SECTION. Secretary, R. H. Carlton, General Electric Company, Schenectady, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, I. S. Mitchell, Georgia Railway & Power Company, Atlanta, Ga. Annual convention, Tybee, Aug. 15-17.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MICHIGAN SECTION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MISSISSIPPI SECTION. Secretary, A. H. Jones, McComb City, Miss.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Semi-annual convention, Boston, Oct. 10-11, 1912.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NORTHWEST SECTION. Secretary, N. W. Brockett, Pioneer Building, Seattle, Wash. Annual convention, Portland, Ore., Sept. 11-13, 1912.

NATIONAL ELECTRIC LIGHT ASSOCIATION, HYDROELECTRIC AND POWER TRANSMISSION SECTION. Secretary, Farley Osgood, Public Service Electric Company, Newark, N. J.

NATIONAL ELECTRIC CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, W. L. Smith, Concord, Mass.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary-Treasurer, Franklin H. Wentworth, 87 Milk St., Boston, Mass. Next annual meeting New York, May 13-15, 1913.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary-Treasurer, Richard Valentine, Janesville, Wis.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F.

Tupper, 60 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New Orleans Electrical Contractors' Association. Secretary, S. J. Stewart, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

New York Electrical Credit Association (affiliated with the National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

New York Electric Railway Association. Secretary, Charles C. Dietz, United Traction Company, Albany, N. Y.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Annual meeting, Akron, Ohio, Nov. 21 and 22, 1912.

Pennsylvania Electric Association (State Section N. E. L. A.). Secretary-Treasurer, Walter E. Long, 1000 Chestnut St., Philadelphia, Pa. Annual convention, Bedford Springs, Pa., Sept. 4-6, 1912.

Pittsburgh Electrical Booster Club. Recording Watt, George H. Criss, 1806 Union Bank Building, Pittsburgh, Pa. Meeting, first Monday each month.

Rejuvenated Sons of Jove. Jupiter, R. L. Jaynes, Pittsburgh, Pa.; Mercury (Secretary), E. C. Bennett, St. Louis, Mo.

Society for the Promotion of Engineering Education. Secretary, Prof. H. H. Norris, Cornell University, Ithaca, N. Y.

Southwestern Electrical & Gas Association. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Texas.

Vermont Electrical Association. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill. Convention, St. Louis, Mo., Jan. 28-30, 1913.

Western Society of Engineers. Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meeting, fourth Monday of each month, except January, July and August. Annual meeting, Tuesday after Jan. 1 each year.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 23, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,033,085. DIFFERENTIAL MICHROPHONE TRANSMITTER; J. J. Comer, Chicago, Ill. App. filed Oct. 24, 1910. Carbon type, particularly for musical transmission.

1,033,086. DIFFERENTIAL MICROPHONE TRANSMITTER; J. J. Comer, Chicago, Ill. App. filed Oct. 24, 1910. Stationary intermediate electrode.

1,033,087. DIFFERENTIAL MICROPHONE TRANSMITTER; J. J. Comer, Chicago, Ill. App. filed Oct. 24, 1910. Has a plurality of sets of interposed electrodes.

1,033,095. ROTARY VARIABLE CONDENSER; H. Gernsback, New York, N. Y. App. filed March 1, 1912. Flexible sheets of dielectric and conducting material wound on drums.

1,033,098. TELEPHONE RECEIVER; J. Halldow, Elyria, Ohio. App. filed Oct. 8, 1908. Metallic shell with insulating lining.

1,033,104. SUSPENSION OF TROLLEY WIRES; M. Jellinek and J. F. De Tóváros, Budapest, Austria-Hungary. App. filed April 26, 1910. Catenary suspension with sliding clamp on a grooved trolley wire.

1,033,114. TELEPHONE RELAY OR REPEATER; C. D. Morris, Washington, D. C. App. filed Oct. 10, 1910. A casing with a lining for magnetic protection.

1,033,117. STARTING DEVICE FOR ELECTRIC MOTORS; M. F. Owens and A. T. Marshall, Hartford, Conn. App. filed April 12, 1910. A heavy fuse for starting and light fuses for running.

1,033,122. ELECTRICALLY HEATED COMB; E. Schwartz, Chicago, Ill. App. filed Jan. 2, 1912. A handle with a detachable comb and interchangeable curling iron.

1,033,123. FUSE DEVICE; E. O. Schweitzer and A. Herz, Chicago, Ill. App. filed April 3, 1907. Has a spring for crushing the fuse when it softens.

1,033,126. METHOD OF PRODUCING ENDOTHERMIC COMPOUNDS FROM THEIR COMPONENTS; W. Siebert, Rheinfelden, Baden, Germany. App. filed Feb. 27, 1911. A gaseous component is distributed in the form of a whirl to spread the arc in an electric furnace.

1,033,135. TELEPHONE SYSTEM; A. H. Weiss, Chicago, Ill. App. filed Nov. 30, 1908. Simplified switchboard wiring.

1,033,152. PUSH-BUTTON SWITCH; C. A. Clark, Hartford, Conn. App. filed Nov. 23, 1909. Two-button wall type.

1,033,166. TROLLEY BASE; C. E. Gierding, Newark, N. J. App. filed Sept. 6, 1911. Yielding abutment to minimize shock.

1,033,188. DYNAMO-ELECTRIC MACHINE; C. C. Mitchell, Madisonville, Ohio. App. filed Nov. 7, 1911. Bracket for centering the rotary element.

1,033,205. ELECTRODE; E. C. Speiden, Niagara Falls, N. Y. App. filed May 5, 1911. Overlapping plates; extensible.

1,033,208. REAR SIGNAL FOR AUTOMOBILES; A. B. Stites, Plainfield, N. J. App. filed Feb. 26, 1912. The controller is carried by the steering shaft.

1,033,221. ELECTRIC MOTOR; E. S. Wetmore, College Springs, Ia. App. filed Jan. 26, 1911. Electromagnet with oscillating armature.

1,033,228. DRY-BATTERY CELL; J. W. Brown, Cleveland, Ohio. App. filed Sept. 14, 1906. Zinc cup and carbon rod with metal core.

1,033,243. CONTROLLING APPARATUS FOR RAILWAY SWITCHES AND SIGNALS; H. W. Griffin, New York, N. Y. App. filed Dec. 30, 1909. Controlling circuit for electro-pneumatic system.

1,033,257. APPLICATION AND DISTRIBUTION OF ELECTROMOTIVE POWER FOR USE IN STARTING MACHINERY; G. W. Mascord, Barnes, London, England. App. filed Jan. 12, 1907. Motor drive for printing presses, etc.

1,033,275. CONNECTION FOR RUNNING INCANDESCENT LAMPS AND ARC LAMPS IN COMMON; W. Schaffer, Berlin, Germany. App. filed Jan. 13, 1910. Alternating-current system with autotransformer and resistance regulator.

1,033,286. ELECTRIC DUMB-WAITER CONTROL; M. Spann and I. Concoff, Portland, Ore. App. filed Feb. 27, 1911. Controlled from the basement.

1,033,333. TROLLEY WHEEL; W. E. Marshall, Danville, Ill. App. filed Aug. 26, 1911. Bridging guard arms.

1,033,335. TROLLEY HEAD; J. C. Mattison, Vancouver, B. C., Canada. App. filed Sept. 22, 1911. Gives lateral freedom of motion to the wheel.

1,033,340. ELECTRIC SWITCH; S. Morris, Hartford, Conn. App. filed May 25, 1909. Driving connection between the handle and the spindle of a rotary snap switch.

1,033,341. ELECTRIC DANGER ALARM FOR RAILROADS; P. W. Mosher, Stockton, Cal. App. filed July 26, 1911. Third-rail alarm circuit.

1,033,344. TROLLEY WHEEL; H. Prack, Ottawa, Ill. App. filed July 3, 1911. Lubricating construction.

1,033,345. TROLLEY WHEEL; H. Prack, Ottawa, Ill. App. filed Aug. 7, 1911. Improvement on Patent No, 1,033,344.

1,033,347. ELECTRIC LAMP; W. A. Richardson, Chicago, Ill. App. filed July 3, 1911. Automatic cut-out for a filament lamp.

1,033,357. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 23, 1910. Regulation of compensatory storage-battery systems.

1,033,379. DYNAMO-ELECTRIC MACHINE; J. Burke, Erie, Pa. App. filed Sept. 23, 1907. Stamped laminated segments arranged for ventilation.

1,033,384. HIGH-VOLTAGE PROTECTIVE DEVICE; N. J. Conrad and E. O. Schweitzer, Chicago, Ill. App. filed Sept. 8, 1910. A fuse protected by cork in a bath of carbon detrachloride.

1,033,409. APPARATUS FOR MEASURING THE RATIO OF TWO ELECTRIC CURRENTS; L. Joly, Paris, France. App. filed Marcn 14, 1911. A magnet with a core and oppositely disposed coplaner coils.

1,033,435. ART OF ELECTROTYPING; M. A. McKee, Westerly, R. I. App. filed Nov. 19, 1910. Depositing an additional copper backing.

1,033,473. ELECTRICAL MAKE-AND-BREAK CIRCUIT DEVICE. W. S. Ryan, New York, N. Y. App. filed Dec. 14, 1910. Motor-driven commutator with projecting interrupter.

1,033,474. CONNECTIONS FOR REGULATING THE SPEED OF ALTERNATING-CURRENT COMMUTATOR-MOTORS; M. Schenkel, Charlottenburg, Germany. App. filed Sept. 6, 1911. Has a plurality of sets of shifting brushes.

1,033,508. APPARATUS FOR CONTROLLING THE CHARGE OF STORAGE BATTERIES; J. L. Woodbridge, Philadelphia, Pa. App. filed Oct. 11, 1909. Automatic interruption on charging.

1,033,509. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed Dec. 6, 1909. For relieving storage batteries in combined distribution system.

1,033,519. ELECTRIC MOTOR-DRIVE MECHANISM; C. P. Banzhof, Lancaster, Pa. App. filed July 3, 1911. Control for sewing machine drive, etc.

1,033,529. THERMOSTATICALLY CONTROLLED APPARATUS; M. J. Brierty, Chicago, Ill. App. filed Dec. 22, 1911. For heating and ventilating systems.

1,033,542. ELECTRICALLY OPERATED VALVE; G. W. Collin, Bridgeport, Conn. App. filed July 17, 1909. Steam admission valves for car heating, etc.

1,033,543. ELECTRIC SOLENOID; G. W. Collin, Bridgeport, Conn. App. filed June 1, 1910. For controlling valves, etc.

1,033,560. LIGHTING SYSTEM FOR VEHICLES; L. R. Duval, New York, N. Y. App. filed June 1, 1910. Motor-driven dynamo for side, search and tail lights.

1,033,587. DEVICE FOR PASSING CABLES THROUGH PIPE LINES; B. B. Hodgman, East Orange, N. J. App. filed April 15, 1910. A shaft with a two-compartment cup.

1,033,619. TELEPHONE ATTACHMENT; J. E. Ross, Springfield, Mo. App. filed Aug. 29, 1911. Ear-tube attachments for a receiver.

1,033,629. METHOD OF AND APPARATUS FOR AMPLIFYING VARYING ELECTRIC CURRENTS; L. W. Southgate, Worcester, Mass. App. filed Oct. 26, 1908. Polyphase inductor alternator with varying field.

1,033,725. AUTOMATIC TELEPHONE EXCHANGE; E. Neuhold, Friednau, Berlin, Germany. App. filed April 2, 1910. Disconnecting and restoring devices.

1,033,726. ELECTRIC HAIR COMB; J. T. Niblett and W. H. Cadman, Stockwell, and London, England. App. filed May 13, 1912. Magneto operated by oscillation.

1,033,754. INCLOSED ELECTRIC FUSE; L. B. Buchanan, Woburn, Mass. App. filed Jan. 11, 1910. Cartridge type with indicator.

1,033,762. ELECTRODE FOR ILLUMINATING PURPOSES; I. Ladoff, Cleveland, Ohio. App. filed May 3, 1906. Compressed and partially fused ilmenite ore.